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Unsoundness in Aluminum Cast

Results of Experiments on Porosity and Unsoundness of No. 12 Alloy of Alumin —Blowholes Are Function of Pouring Temperature, Time Metal is Held in Furnace, and Other Factors

By ROBERT J. ANDERSON

THE study of defects in nonferrous metals and alloys is still in a very backward condition as compared with iron and steel; in aluminum, systematic researches, utilizing the principles of physical metallurgy, have begun only in the last few years. The most common light aluminum alloy used in the United States for the ...stings is that one ...rcles as No. 12, ... of 92 per cent ... per cent copper.

... by the permission of the ...ates bureau of mines. It is ... a forthcoming publication of ... Robert J. Anderson, is metal... of ... mines experiment station, Pitts... the specimens illustrated. Figs. 3 to ... 23, were etched with NaOH.

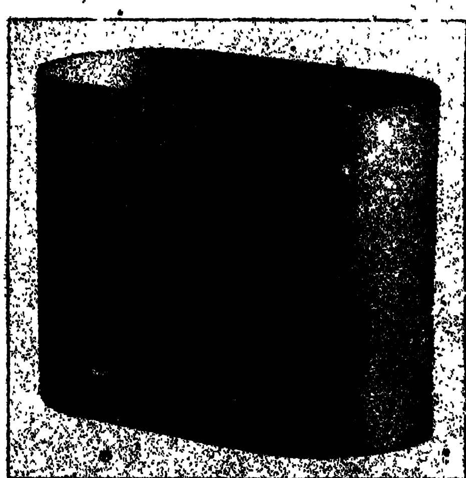
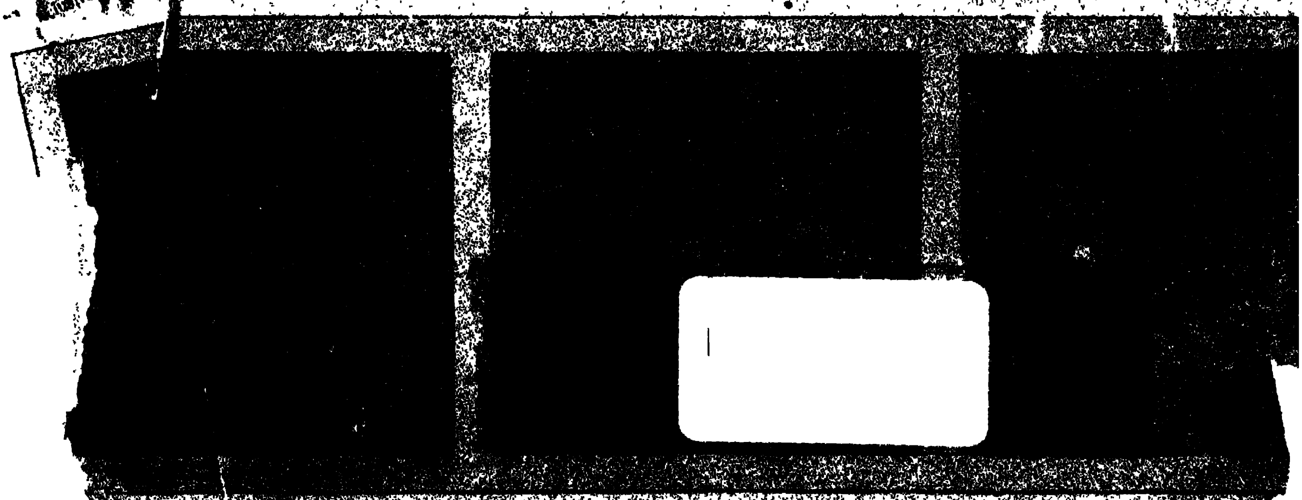


FIG. 1—FORM OF THIN SHELLS POURED IN THE CASTING EXPERIMENTS

This alloy, or others of ... composition, is employed ... variety of castings, ... founders are doubtless ... with it than any other ... founders have long rec... pouring temperature is ... factor in ... the castings, ... stress has ... ness and the factors at ... engineers and founders ... the opinion that there ... specific gravity, is ... virtue of aluminum alloy ... a matter of fact, howe... ... are light, ... castings. There are, ... the kin

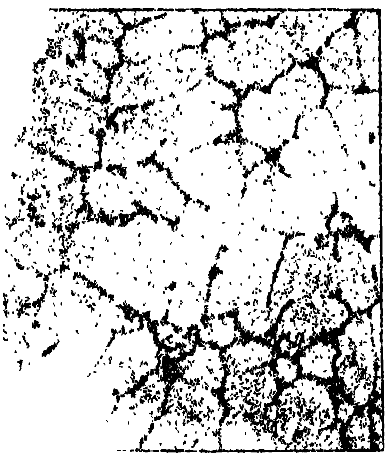


...Y IN 92-8 ...DE-

...as by the design of the ...e molding practice, and ...of melting, but the ideal ... to turn out the best pos... castings within the limitations ...d.

...onnection with the studies now made by the bureau of mines metallurgy of aluminum, con... has been given to the gen... of blowholes, porosity, ...ness in the 92-8 aluminum-... The total results of ...eady made and con... not yet in hand, but ...t this time, available some ...g the influence of pour... ...ure and length of melt... ...on blowholes and un... The results of the com... will appear later in the ...u of mines publication ..., "Blowholes, Porosity ...ness in Aluminum Alloy ...

...oundness in sand-cast alloys is no myth, but a ...ious importance is gen... ...ized by the light alloy Porosity in castings that



...POURED AT 650 DEGREES, ...AVERAGE STRUCTURE, ...ION; 75 DIAMETERS

...oline test or ...ure constitutes manufacturers of ...cast castings. ... aluminum-alloy cast... ...ie have been more or ... this statement can read... ...ded by examining polished ...tions of samples taken at ...m. Typical examples are shown ...gs. 2 and 3, where the former ... macrograph at five diameters of ... section cut from a crankcase and the latter a macrograph at seven diameters of a section cut from a portion of another crankcase showing seepage in the open gasoline test. These are not exaggerated examples at all, and more or less similar results can be observed by examining almost any casting. The conclusion should not be drawn that all aluminum-alloy castings are totally unsound throughout all parts, the term unsoundness is only relative at best. In a com-

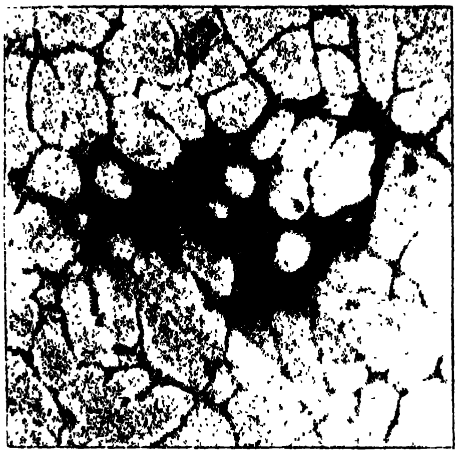


FIG. 7 SAME AS FIG. 6 BUT SHOWING UNSOUNDNESS; 75 DIAMETERS

plicated casting, some portions will be likely to be more unsound than others, but at the present writing unsoundness would appear to be presupposed in connection with aluminum-alloy castings. Some tests have been made in connection with the present work for the purpose of studying the effect of pouring temperature on the soundness of the 92-8 aluminum-copper alloy and also the effect of time of melting on the same property. In the tests about to be described, confirmatory evidence of already known facts has been obtained and some new data have been made available.

The present article will not deal at all, except to mention it, with the influence of furnace atmosphere on the properties of aluminum alloys, but that is a question which merits serious consideration by metallurgists and one that seemingly has been given entirely too little attention. The question of the solubility of gases

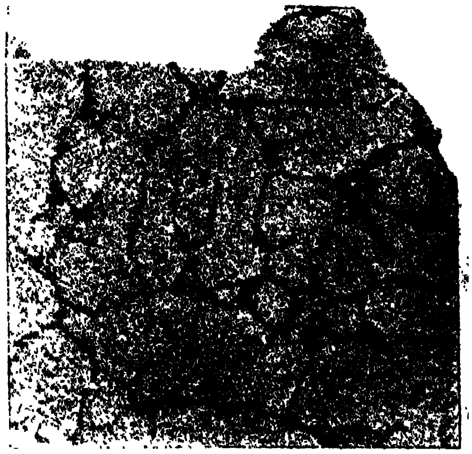


FIG. 8—HEAT B, POURED AT 850 DEGREES, FROM THE BAR, AVERAGE STRUCTURE, SOUND PORTION; 75 DIAMETERS

in aluminum and the formation of loose compounds at elevated temperatures is one that apparently has considerable importance, and studies in this direction should prove fruitful. However, only the briefest men... tion of these matters can be made now. Various elaborate methods, in the case of steel, have been perfected for the prevention of blowholes, and it would not appear to be straining analogy to say that a consideration of the many methods in vogue for preventing unsoundness in steel might possibly prove of value in studying the same defect in aluminum-alloy castings.

In the preliminary tests made in connection with the present work, small heats of about 25 pounds each of the 92-8 alum... were made up ... charged as fol... amount of 50-50 ... alloy was first me... bago-clay crucible, ... furnace; when the ... melted, enough virgin ... got, in the form of ... notch bars, together with ... per cent of No. 12 ... 10 ... and ...

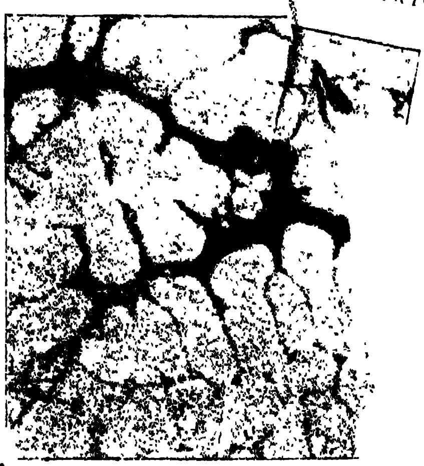


FIG. 9 SAME AS FIG. 8, BUT SH... GRANULAR UNSOUNDNESS; 75 ...

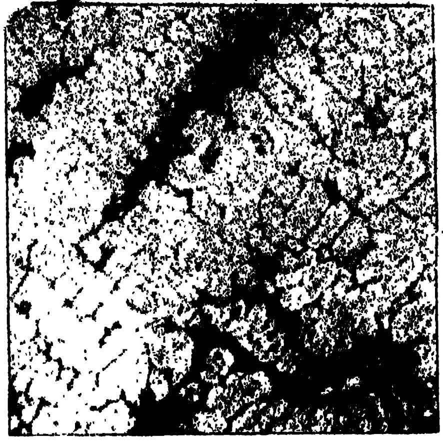
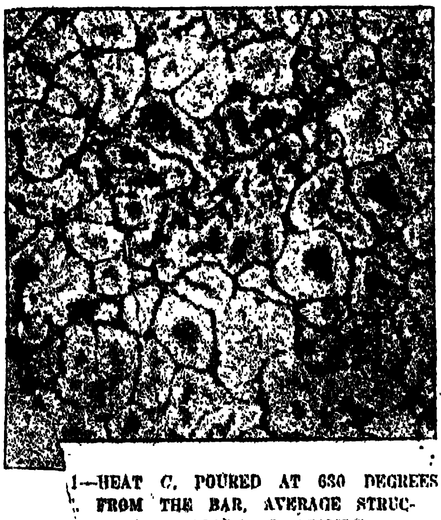


FIG 10 HEAT *B*, POURED AT 850 DEGREES CENT. FROM THE BAR, AVERAGE STRUC-NESS; 75 DIAMETERS

were added to make up the heat. Six sets of castings were poured, and the essential information is summarized in Table I. The castings were simply thin shells as shown in Fig. 1, the dimensions being roughly 7⅛ by 6 by 4⅛ inches and ⅛-inch thick. The cut-out portion is the place from which a microsection was taken for microscopy. Two kinds of castings were poured from the first six heats. (1) the thin shells, and (2) bars, 0.75 inch square by 12 inches long. The shells are hereafter referred to as castings and the bars as bars. Castings of different thicknesses were thus poured for the purpose of ascertaining whether any exaggeration of defects might be traced to size of section under otherwise identical conditions. The castings were poured in ordinary sand molds properly rammed and vented; each thin shell was poured in a single mold and its companion bar in another separate mold. In the first si[illegible] the influence of pouring te[illegible] and length of time in m[illegible] soundness was observed. Duplicate runs, in which the data were practically the same as shown in Table I, were made for checking purposes. The average chemical composition of the first set of six castings and bars was, copper 7.62 per cent, iron 0.39 per cent, silicon 0.25 per cent, and aluminum 91.73 per cent by difference.



1—HEAT *C*, POURED AT 630 DEGREES ... FROM THE BAR, AVERAGE STRUC-...RE, SOUND PORTION; 75 DIAMETERS

Additional Tests

Additional tests on the effect of pouring temperature alone on unsoundness were performed by making up 60-pound heats of the 92:8 aluminum-copper alloy, in the manner described, and pouring 1.50-inch square by 12 inches long bars, at 50 degrees Cent. intervals as shown in Table II. Duplicate runs were made for the purpose of checking.

In the tests summarized in Table II, a charge of 60 pounds was heated rapidly to 975-1000 degrees Cent.; the crucible was then removed from the furnace, and bars were poured at

FIG 12—SAME AS FIG 11, BUT SHOWING UNSOUNDNESS 75 DIAMETERS

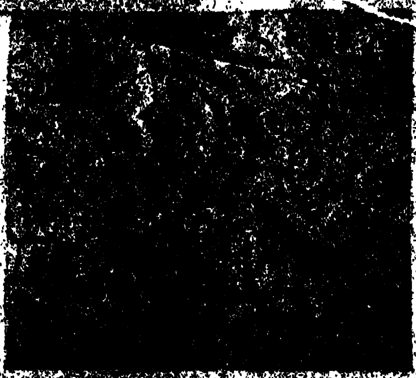
50 degrees Cent. intervals from the same pot by allowing the melt to cool between pours. The range of pouring temperature, as indicated in Table II, was from 950 to 650 degrees Cent. The average chemical composition of a composite sample of the 1.50-inch square bars was copper 7.55 per cent, iron 0.36 per cent, silicon 0.29 per cent, and aluminum 91.80 per cent by difference. In connection with these tests, some interesting information on the contraction of the No. 12 alloy was furnished by examination of the frozen pouring gates, and this will be dealt with in a later paragraph. The resultant castings and bars, referred to as *A* to *M* inclusive were examined for surface appearance and microscopically for general characteristics and unsoundness. Polished microsections of both castings and bars were examined macroscopically and machined surfaces were examined for blowholes. All temperatures in the

FIG. 13—HEAT *D*, POURED AT 640 DEGREES CENT., FROM THE BAR, UNSOUNDNESS; 75 DIAMETERS

above experiments were taken with a base-metal thermocouple of the pyro type which was calibrated to insure its accuracy.

The castings and bars poured in heats *A* to *M* inclusive were examined macroscopically and microscopically for blowholes, porosity, and general soundness. In examining castings for relative unsoundness, this defect can best be judged by simply inspecting polished or machined surfaces. Microscopic examination is not so useful. In the present experiments, bars cast from the various heats were machined smoothly by milling, and the surfaces were inspected for holes. Microsections from the bars and castings were also prepared and studied. It has been previously stated that soundness in aluminum-alloy castings is a relative term at best and that all castings are more or less porous. Hence, the term "soundness" should not be regarded as absolute but as roughly descriptive. Figures 4 and 5 are indicative of what a macrograph can show as regards soundness. The former shows the surface appearance of a microsection cut from a 0.75-inch square bar cast

FIG. 14—HEAT ... CENT., FR... STRUC...



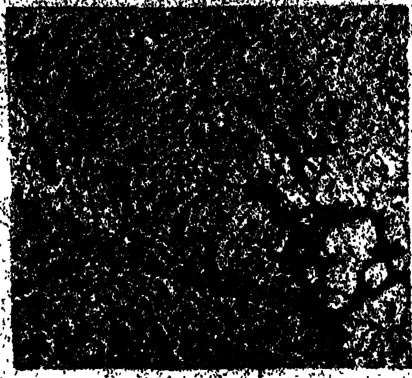


FIG. 15—HEAT E, POURED AT 950 DEGREES CENT., FROM THE BAR, AVERAGE STRUCTURE, SOUND PORTION, 75 DIAMETERS FIG. 16—HEAT E, POURED AT 950 DEGREES FROM THE CASTING, UNSOUNDNESS; 75 DIAMETERS FIG. 17—HEAT F, POURED AT 700 DEGREES CENT., FROM THE CASTING, AVERAGE STRUCTURE, SOUND PORTION, 75 DIAMETERS

from heat *D*; the latter is a similar macrograph from heat *E*. Heat *D* was poured at 640 degrees Cent., and heat *E* at 950 degrees Cent. Machined surfaces also show relative unsoundness fairly satisfactorily. Macrographs on samples from heats *G* to *M*, inclusive, prove extremely instructive and a few of these are reproduced in Figs. 19 to 22 and Fig. 24, inclusive. In general, the number of blowholes per unit area in a casting increases with increasing pouring temperature. Fig. 24, on heat *M* poured at 650 degrees Cent., shows no holes at all, but many holes may be seen in Figs. 19, 20 and 21.

A detailed elucidation of the micrographs in Figs. 6 to 18, inclusive, may prove interesting. It may be noticed in comparing the microstructures of the 0.75-inch bars and the ⅛-inch thick castings, that in the former the grain size is much larger than in the latter. This is, of course, to be expected since the thin casting is chilled much more rapidly by the sand than a thick one; a thick casting may even exhaust the thermal capacity of a sand mold, before it freezes, provided conditions are conducive to that end. The micrographs give evidence of at least three kinds of unsoundness: (1) That which is plainly intergranular and may be due to an actual forcing apart of the grains by gas attempting to find an

FIG. 18—SAME AS FIG. 17, BUT SHOWING UNSOUNDNESS—100 DIAMETERS

exit to freedom, or to intergranular occluded foreign matter which is a source of weakness at best and in effect results in unsoundness; (2) that due to actual liberation of gas which is entrapped at the moment of final freezing; and (3) that which is the result of a balled-up oxide occluded in quite large gobs, in an indiscriminate fashion in the frozen alloy. Intergranular occluded foreign matter, whether oxide or what not, is well shown by Figs. 9 and 13, while unsoundness due to the third cause mentioned is illustrated by Fig. 16. Actual blowholes or holes from which occluded foreign matter has dropped on polishing are shown in the low power illustrations in Figs. 19, 20 and 21.

The proposal has been made by Wheeler P. Davey and others, and actually carried out in some instances, that X-ray photographs of castings would prove useful in determining the soundness of castings. In fact, Tonamy (Jour. Inst. Metals, vol. 14, 1915, pp. 200-203) proposed to decide by radiographs whether or not certain copper castings were worth machining. Now some machine shop scrap is the result of finding the porosity and blowholes after a few cuts with a milling cutter, for example, in machining aluminum-alloy motor castings. In connection

...0 DEGREES; 7 DIAMETERS FIG. 20—HEAT H, POURED AT 900 DEGREES; 7 DIAMETERS FIG. 21—HEAT J, ... AT 800 DEGREES; 7 DIAMETERS

FIG. 22—HEAT L, POURED AT 7[illegible] DEGREES; 7 DIAMETERS

with the tests described, it was the thought that possibly an X-ray examination would be of assistance in locating the presence of internal blowholes as well as general porosity and sponginess, without cutting the suspected samples and polishing as in metallography. Some radiographs were made of flat plates, 0.25-inch thick, and of bars, 1-inch square. Samples of each were deliberately made porous by pouring at a high temperature in a damp mold, and radiographs on these were compared with radiographs on fairly sound samples correctly poured.

An X-ray tube with a tungsten target was used for radiography. A few radiographs were made on very porous samples obtained from various aluminum foundries. The results of the X-ray work would indicate that this apparatus is of no particular use (for practical purposes) in detecting internal blowholes. In complicated castings, suitable radiographs would entail considerable difficulty in preparation and probably a large number of radiographs would have to be taken on any given casting to decide whether it was worth machining or not. From the practical standpoint, it is difficult to see how the X-ray examination of aluminum-alloy castings has any application at the present time. Actually, it will simplify matters greatly from the machine-shop standpoint to make the castings sound in the first place in the foundry. Also, it may not be altogether out of place to suggest here that it will be foundry economy to produce finished castings on the foundry floor rather than to try to patch them by

Table I

Influence of Pouring Temperature and Length of Time of Melting

Heat	Treatment	Pouring temperature Degrees Cent.	Remarks applying to appearance of castings.
A	Heated the charge to 650 degrees Cent. and poured at once.	650	White, good, smooth appearance.
B	Heated the charge rapidly to 850 degrees Cent. and poured at once.	850	Tinted with oxidation stains; rough appearance; many surface holes.
C	Heated the charge rapidly to 880 degrees Cent., removed from furnace and cooled to 630 degrees Cent.	630	White, fair appearance; cold [illegible]
D	Heated the charge to 650 degrees Cent., and held in the furnace for one hour at 650-720 degrees Cent.	640	White, fair appearance; cold [illegible] so marked as in C.
E	Heated the charge rapidly to 900 degrees Cent. and held in the furnace for one hour at 900-950 degrees Cent.	950	Oxidation stains; bad looking casting; rough; many surface holes.
F	Heated the charge rapidly to 900 degrees Cent., held in the furnace for one hour at 900-950 degrees Cent.; removed from furnace and cooled to 700 degrees Cent.	700	White, fairly good surface appearance.

(a) Duplicate runs of 25-pound charges were heated in a gas-fired furnace

(b) Average chemical composition was, copper 7.62 per cent; iron, 0.39 per cent; silicon, 0.26 per cent; and aluminum, by difference, 91.73 per cent.

Table II

Metal from the Same Charge Poured at Different Temperatures

Heat	Pouring temperature Degrees Cent.	Remarks applying to appearance of castings
G	950	Soundness, surface appearance and color varies with the pouring temperature.
H	900	
I	850	
J	800	
K	750	
L	700	
M	650	

(a) Duplicate runs of 60-pound charges were heated in a gas-fired furnace to 975-1000 degrees Cent., the crucible was then removed from the furnaces and bars were poured at 50 degrees Cent. intervals.

(b) Average chemical composition was, copper 7.35 per cent; iron, 0.36 per cent; silicon, 0.29 per cent; and aluminum, by difference, 91.80 per cent

FIG. 23—EXPANSION AND CONTRACTION IN 92-8 ALUMINUM COPPER ALLOY. HALF SIZE

later welding and otherwise doping. Turner suggested a supposed expansion of aluminum some years ago, but Chamberlain (Journ. Inst. Metals, vol. 10, 1913, pp. 193-234) in referring to Turner's work stated that the apparent expansion could be accounted for by dissolved gases in the metal. A striking example of the effect of various factors on the contraction of the 92:8 aluminum-copper alloy was shown in the present work in the heads of the pouring gates of the series of bars cast at 50 degrees Cent. intervals, namely, heats *G* to *M*, inclusive. The amount of contraction is a function of the pouring temperature, so far as the limitations of the experiments can show, but whether it is also, and at the same time, connected with dissolved gases is not certain. It is a fact, however,

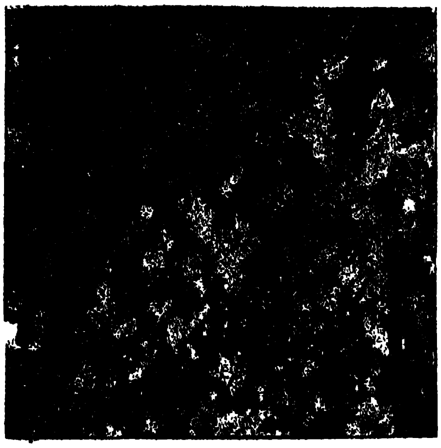


FIG. 24—HEAT M, POURED AT 650 DEGREES 7 DIAMETERS

that a casting poured at 950 degrees Cent. contains more dissolved gases at the moment of pouring than another similar one poured at 650 degrees Cent. The greater solubility of gases in liquid metals with increasing temperatures is a departure from the general laws governing solutions of gases in aqueous liquids.

The effect of temperature, or dissolved gases, or both, on the contraction of the 92:8 aluminum-copper alloy is shown strikingly by Fig. 23. Here gate *G* was poured at 950 degrees Cent. and gate *M* at 650 degrees Cent., and the others at 50 degrees Cent. intervals as indicated in Table II. Gate *G* actually expanded while the shrinkage in gate *M* is marked and apparently normal. Gradations in degrees of expansion and contraction are shown in the other gates depending on the pouring temperature. Gate *J*, poured at 800 degrees Cent., apparently did not contract or expand much; gates *G*, *H* and *I* expanded; gates *K*, *L* and *M* contracted.

It has been hinted that the solubility of gases in aluminum is a cogent factor in governing blowholes, porosity and contraction. This is an important study in connection with the production of aluminum-alloy castings, but only the briefest mention can be made regarding this now. Aluminum metallurgists, however, will doubtless find that a consideration of this question will furnish interpretable data that can be applied to the solution of foundry difficulties in connection with melting practice.

The conclusions drawn from an examination of the rough castings, of machined surfaces of the bars, and of polished microssections cut from both castings and bars are these:

A.—The number of blowholes present in a function of the pouring temperature; the higher the pouring temperature, the greater the number of blowholes and the more unsound is the casting.

B.—Unsoundness varies with the temperature to which the charge was heated; the higher the temperature in the furnace, the more unsound the resultant castings are, irrespective of the pouring temperature.

C.—Unsoundness is a function of the length of time of melting; the longer any melt is held in the furnace, the more unsound are the castings, irrespective of the temperature of heating and the pouring temperature.

It can be readily seen that the factors affecting the soundness of castings can influence one another either favorably or adversely. Thus, pouring an overheated melt at a lower temperature by allowing the charge to cool prior to pouring will aid in minimizing the deleterious effects of overheating. Castings poured at low temperatures are more sound than those poured at high temperatures, but heats held in the furnace for a long time at either high or low temperatures are more unsound than those held for a short time. The most aggravated cases of unsoundness will result from pouring a melt at a high temperature which has previously been grossly overheated and for a long time. There is nothing to lead to the belief that there is a minimum temperature below which it is not safe to go for fear of unsound castings resulting from too low pouring temperature. The results of the experimental heats and also past foundry experience, together with the general information available, would lead to the conclusions that with the methods of melting now in vogue, the heats should be kept at a low temperature in the furnace; melting should be as rapid as possible, i. e., the charge should be poured as soon as it is melted; and the pouring temperature should be so low as is consistent with the metal filling the mold. This means nothing other than close supervision of melting and pouring, together with a study of the appropriate correlation between the molding floor and the furnace room. It will be best to have the molding floor waiting for metal rather than have the furnace room waiting for molds. Close pyrometric control is also presupposed in actual foundry production.

Malleable Iron Burned by Too Much Air

By H. E. Diller

Question: We have been getting good malleable iron with a tensile strength of approximately 50,000 pounds per square inch, but at present the iron smokes as it comes from the furnace and the castings are honeycombed. We melt a charge in 3 hours and 10 minutes. We charge at 1.30 per cent silicon and get iron with 0.47 per cent silicon and 1.80 per cent carbon. The brown smoke comes from the metal before it is hot enough to pour so I do not see how it can be burnt.

We are using fuel oil. How much should be required to melt a ton of metal?

Answer: There is no doubt but that you are burning your iron by using an excess of air. The amount of air should be cut down and you should not try to melt your iron so fast. Oxidation of the metal also burns out silicon and carbon. The silicon should not be reduced more than 0.25 per cent. The more carbon you burn out the higher you must heat the iron in order to get it to run properly. This in turn tends to burn out more carbon.

Iron will burn with a large excess of air even before it is hot enough to pour. An extreme illustration of this is the burning of steel with the oxyacetylene flame. In this process the edge of the steel is heated with the flame, then an excess of o[illegible]a is turned on and this cuts the [illegible]el by burning it.

You should be able to melt [illegible]n using 35 gallons of oil to the ton.

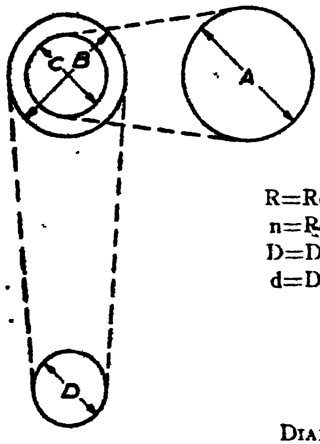
Artificial Molding Sand

W. J. Nelson, president and general manager of the West Albany Molding Sand Co., West Albany, N. Y., announces that after 10 years spent in trying out different processes he has developed an artificial sand which can be made on a commercial basis. The advantages claimed for this sand are that it is bonded so that it will withstand the flow of the metal without cutting, but contains no excess bonding material; it is uniform and of the proper size to allow the gases to escape without being too course, and it is free from vegetation which would develop gas when burned by the hot metal, thus eliminating one trouble.

Note—This sheet may cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

DATA ON BELTS AN[illegible]EYS

By W. L. Try[illegible]



Revolutions Per Minute of Driven Pulleys

The number of revolutions per minute of a driven pulley is equal to the product of the revolutions per minute of the driving pulley and the diameter of the driving pulley divided by the diameter of the driven pulley. Or where

R=Revolutions per minute of the driven pulley.
n=Revolutions per minute of the driving pulley.
D=Diameter of the driven pulley.
d=Diameter of the driving pulley.

$$R=\frac{d\ n}{D}$$

Diameters of Driven Pulleys

The diameter of a driven pulley is equal to the product of the revolutions per minutes of the driving pulley and the diameter of driving pulley divided by the revolutions per minute of driven pulley.

$$D=\frac{d\ n}{R}$$

Diameters of Driving Pulleys

The diameter of a driving pulley is equal to the product of the diameter of driven pulley and revolutions per minute of driven pulley divided by revolutions per minute of driving pulley.

$$d=\frac{D\,R}{n}$$

Revolutions Per Minute of Driving Pulley

The number of revolutions per minute of a driving pulley is equal to the product of the diameter of driven pulley and the revolutions per minute of driven pulley divided by the diameter of driving pulley.

$$n=\frac{D\,R}{d}$$

(*Continued on Data Sheet No. 300*)

DATA ON BELTS AND PULLEYS

By W. L. Tryon

(*Continued from Data Sheet No. 299*)

Revolutions Per Minute of Driven Pulley in Compound Drive

The number of revolutions per minute of the second driven pulley is equal to the product of the revolutions of the first driving pulley and the quotient obtained by dividing the product of diameters of driving pulleys by the product of diameters of driven pulleys. Or where,

A and B=Diameters of the driving pulleys.
C and D=Diameters of the driven pulleys.
N=Revolutions per minute of second driven pulley.
n=Revolutions per minute of first driving pulley.

$$N=\frac{n\ A\ B}{C\ D}$$

Pulley Diameters in Compound Drive

Place the revolutions per minute of the driving pulley as the numerator of a fraction and the revolutions per minute of the driven pulley as the denominator, and reduce this fraction to its lowest terms. Then resolve both numerator and denominator into two factors and multiply each pair of factors (that is one in the denominator and one in the numerator) by a number which will give pulleys of large enough diameter.

Example: The number of revolutions per minute of A=320 per minute. The number of revolutions per minute of D=900 per minute.

$$\text{Fraction}=\frac{320}{900}=\frac{16}{45}\ \text{resolve into factors}\ \frac{8 \times 2}{9 \times 5}$$

$$\text{Multiplying pairs by same numbers}=\frac{(8 \times 1) \times (2 \times 4)}{(9 \times 1) \times (5 \times 4)}$$

$$\text{or}\ \frac{8 \times 8}{9 \times 20}$$

∴ 8 and 8 are diameters of driven pulleys C and D and 9 and 20 are diameters of driving pulleys.

(*Continued on Data Sheet No. 301*)

[illegible] will be made for all contributions on foundry and pattern shop practice suitable for pu[illegible]

Electric Furnace Improves Gray Iron

Duplex Process of Melting in a Cupola and Finishing in an Electric Furnace is Advocated for Certain Classes of Gray-Iron Castings Where Quality is the First Requisite

By GEORGE K. ELLIOTT

THE central facts and fancies embodied in this paper are either taken from or inspired by divers experiences with a basic-bottom Heroult electric furnace at the plant of the Lunkenheimer Co., Cincinnati. Inasmuch as these experiences extended over a period of nearly two years, and as the electric furnace is presented in a service different from usual, the author feels that his subject, at least, is justified by both a reasonably ample observation and a certain novelty of matter.

The growth of the electric furnace in the field of steel castings has been widespread and irresistible; but, so far, the homely gray-iron casting has been beneath its exalted attention. Or, is it that the cupola furnace, venerable and efficient to a remarkable degree, has been a citadel too mighty to be overwhelmed by the invasion of the electric furnace, as were the established furnaces of the steel foundries? However it may be the author believes the electric furnace has a very fair chance to break through into the domain of iron castings, at points in the line where the hammering of modern engineering for supergrades of castings is rapidly effecting a perceptible breach.

ses Requiring Special Iron

rd to gray-iron castings, it denied that today there are cl of castings for which the insistent demand is for physical properties of a higher order than are commonly characteristic of such iron. Possibly every branch of engineering has some castings that should be, and sooner or later may have to be, made of better gray iron than is now used. One case, and the direct cause of the experiences here related, is that of steam valves for high-pressure and superheated steam. Both pressures and temperatures of the steam used in power plants have passed through a period of exceptional growth, placing upon the apparatus for handling steam severer demands than ever before. Similar is the case of cylinders for locomotives using superheated steam. Also there is the case of cylinders for internal combustion engines.

The two prime qualities most generally wanted in high-grade gray cast iron are strength and solidity, properties which usually are concurrent. The best strength gray iron shows is when under compression, and its worst, under impact and vibration; between come transverse strains and tension. If the cases are studied in which unusual strength of iron is required, it is discovered that almost always the castings are to be used where they will be subjected to either impact, vibration or tension; or, in fact, where cast iron is at its greatest disadvantage.

Solidity Defined

Under the head of solidity may be included a number of related items such as density, closeness of grain and freedom from subcutaneous imperfections such as slag inclusions, graphite segregations, blow-holes, shrink-holes, and the like. Solidity is an excellent goal for the aspiring foundryman; but, in going after high specific gravity he has to beware that he is not lured out from the realm of true gray iron into the dangerous domain of mottled and white irons where brittleness lurks to impair the impact strength of castings, and hardness to ruin their machinability.

Strong irons without exception require high pouring temperatures because they have high melting points and minimum fluidity. The irons most easily melted and, consequently, the most fluid ones, have high percentages of phosphorus in their make-up. Medium and high phosphorus irons comprise by far the greatest part of the melt of the gray-iron foundries of the country. They are the popular casting irons; and it is no extravagance to say that phosphorus has done as much or even more than any other element to popularize gray iron for castings. Still, phosphorus has the grave fault of unfavorably affecting the strength of iron, a thing it accomplishes by forming in the iron mass a network of structurally free phosphide which is quite brittle. Although easily fluid, high phosphorus irons are brittle and generally lacking in strength; conversely, tenacious, strong irons are necessarily low in percentage of phosphorus contained. The well known fact that strength and fluidity do not go hand in hand brings to light the greatest defect of the cupola furnace—its thermal limitations. It is the foundryman casting strong iron who knows best these limitations. The complete melting operation as it takes place in any furnace is divided into three obvious stages—preheating, melting proper, and superheating. For the first two, the cupola is the furnace preeminent; but for superheating it is not the same paragon of excellence.

All ordinary grades of gray iron—those with medium and high percentages of phosphorus—cannot be melted more easily or more economically than in the cupola. For melting efficiency this furnace takes precedence over its two closest rivals—the reverberatory or air-furnace, and the regenerative open-hearth furnace. For simplicity of construction, low cost of installation and upkeep, ease of operation, and economy of melting, it has no real competitor; and there is no probability that, for the great run of ordinary gray-iron castings, it ever will be displaced, although its improvement is conceivable. From the standpoint of process alone, no fault can be found with the cupola; but, from the high ground of product, it shows defects. The two worst of these are its weakness as a superheater for molten iron, and its incapacity as a refiner. The cupola is not a refining furnace and sometimes its hottest possible iron is not hot enough for the best casting results to be secured.

Hotter Iron is Obtained

The thermal limitations of the cupola are inflexible and often tenacity has to pay the price of fluidity. If the demand for supertenacious and solid iron also becomes inflexible, there arises a dilemma which is capable of but one solution, and that is, the attainment of hotter iron. This can be done either through the elimination of the cupola with the substitution of a better superheating furnace, or through retaining the cupola and supplementing it with a more capable superheating furnace. In view of the unequaled economy of the cupola for preheating and melting, a method of supplementing is preferable. This means the introduction of a duplex process into the gray-iron foundry.

A paper presented at a recent meeting of the American Electrochemical society, held in New York City. The author, George K. Elliott, is chief chemist of the Lunkenheimer Co., Cincinnati.

Duplex processes are well established and of excellent repute among makers of steel; but, for the production of gray iron, they have been entirely neglected, leaving virgin a promising field for development in the making of molten iron for the highest grade of gray-iron castings. For a supplemental furnace to the cupola, there are several eligible types. Among these are the reverberatory furnace, the regenerative furnace and the electric furnace. The air furnace, the author hardly considers sufficiently suited to the work. The regenerative furnace promises better, especially where a large tonnage is to be handled at one time. Still, in the end, the author believes the arc electric furnace presents the most alluring possibilities for really extraordinary castings.

The foundry with which the author has been connected has made a specialty of high-pressure steam-valve castings with extreme solidity exacted, and the tenor of his experiences there has been such as to prejudice him strongly in favor of the basic-bottom arc electric furnace as the best auxiliary for the cupola in a duplex process for the production of truly high-class gray-iron for castings having rigid requirements.

Basic Lining Refines

At this point we anticipate the question as to why the basic furnace is preferred. If superheating only is desired, it is entirely probable that the acid furnace should be given the preference; but if an important amount of refining is advantageous, the basic furnace should be used. It is true that the acid arc electric furnace exerts a considerable refining influence by virtue of the reducing condition so readily maintained in it. On the other hand, the refining tendency of the basic furnace is so much more pronounced and so readily responsive, that the iron charge is perforce refined at the same time it is being superheated. By the time the charge has reached the pouring temperature it also has reached a highly refined condition; and, among other results, the sulphur has been reduced very materially, provided, of course, the proper basic and reducing slag has been maintained.

Sulphur in cast iron has so long been considered a necessary evil that its presence not only is commonly condoned, but occasionally is credited with certain benefits. No doubt there are a few of these last, for instance, where it aids in producing chill; but, in general, there is good reason to believe that iron is much better for its absence. That it induces unsoundness when in excess is general knowledge in foundries specializing in castings of a solidity that is a matter of severe test; high pressure valves are an example. Sluggishness of metal is a closely allied evil that travels in the train of sulphur and works unfavorably to solid castings. A medium or high sulphur content is inevitable in the product of the cupola furnace, while in the basic electric furnace its practical elimination is almost a matter of course. The basic electric furnace removes most of the sulphur while the metal is being superheated. This reaction makes possible for the electric furnace certain obvious compensating economies in the choice of raw materials used in the cupola phase of the process. Iron coming from the cupola with 0.100 per cent sulphur, after undergoing about 25 minutes heating in the basic electric furnace under the proper reducing slag generally will contain about 0.030 per cent. One heat the author has in mind was reduced from 0.099 per cent sulphur to 0.022, and another from 0.088 to 0.018 per cent. This possibility of so low sulphur in gray-iron castings may possibly open up a new field for metallurgical investigation.

Carbon regulation, total as well as combined and graphitic, is possible to a most useful extent in the electric furnace. By placing steel scrap in the furnace before adding the molten iron from the cupola, total carbon can with accuracy be reduced to any desired extent. By this simple, unfailing means, gray iron of the socalled semisteel quality may be obtained with great uniformity of composition, structure and strength. Uniformness among different heats, homogeneity in the individual heat, close carbon regulation, and unlimited temperature, are a quartet of benefits of the electric furnace that make possible a realization of those exceptional qualities so often claimed for and so rarely reached by those cupola-compounded mixtures that are pleased to go under the name of semisteel. Correctly balancing the combined and uncombined carbons also is a matter of no great intricacy in the electric furnace by the vicarious means of the silicon content. Indeed, the capricious vagaries of the cupola with reference to carbon control, are replaced in the electric furnace by substantial certainties.

Low Oxidation Loss

Another advantage accruing from the electric furnace is the possibility of making furnace additions of manganese and other elements for particular purposes, without having to expect more or less appreciable losses; the manganese losses are *nil.* Other benefits there are, but they are of a well-known order, so that their repetition here would be commonplace. The one big advantage from the standpoint of composition is the absolute control of mixture, making duplication of results more a matter of correct calculation and less the effect of happy accident.

A concrete example of results actually obtained in everyday running practice may be of interest. A rather ordinary mixture of pig iron and foundry scrap was melted as usual in the cupola, transferred to a basic electric furnace and there superheated and refined under a lime slag. The untreated iron was of a composition regularly giving standard "arbitration" test bars that broke under an average transverse load of 2950 pounds with a deflection of 0.10-inch. After treatment in the electric furnace, the iron gave the same kind of bars breaking at slightly over 4400 pounds and a deflection of 0.115-inch. The specific gravity was increased from 7.10 to 7.25. About 25 minutes was the time of the electric furnace treatment, and the current consumption was 104 kilowatt-hours for 2000 pounds of iron.

Specific Recommendations

At the beginning of the paper the author indicated several concrete cases which seemed to justify this proposed dual process, and now before closing he wants to define broadly some classes of iron castings for which it may be feasible. In the first place, there are those castings for which there is exacted unusual tenacity, solidity and other physical properties. Secondly, there are those castings that are difficult to run on account of having thin sections and relatively large sizes. Thirdly, there are those castings of high quality whose extreme foundry cost is but a very small part of the total cost of the finished article. For the moment, leaving the cupola, attention may well be called to possible advantages in using the electric furnace in connection with the "direct metal" from the blast furnace, [illegible]tric furnace filling the tripl[illegible] mixer, superheater and refi[illegible] process would make possible [illegible]s gray-iron castings almost direct from the blast furnace at a cost very little higher than that of ordinary cupola iron.

To conclude, the author wants to emphasize the fact that the cupola and electric furnace duplex process for gray iron is not recommended by him as a commercial practicability for ordinary iron castings under ordinary circumstances, but rather as a convenient and extremely efficacious substitute for the cupola process for extraordinary castings or for extraordinary circumstances.

The Fire Proof Shoe Co., Jackson, Mich., has been organized and will start operations about the middle of September. This company will manufacture patented asbestos molders' shoes, leggings, etc., which they will sell direct to foundries desiring them.

Modern Gray-Iron Foundry in Utah

In Order to Keep the Mills, Mines and Smelters of a Large Copper Company Going During the War This Shop Reached a Monthly Production of 900 Tons

By T F JENNINGS

WHEN Kipling wrote the famous lines "east is east and west is west and never the twain shall meet" he did not foresee the tremendous changes that were to take place in a few years Trade and commerce have leveled barriers that at one time seemed insurmountable Captains of industry have set up their factories and installed their processes in strange lands Particularly is this true of the casting industry. There are still differences of speech, clothing, customs and manners among the people of the different nations but the methods of producing castings are rapidly becoming identical everywhere

Consider the case of the American west Up to a few years ago, and even yet in the minds of some people the names, Utah Wyoming and California call up visions of buffalo herds and prairie schooners, Indians and gold hunters, Mormons and Danites blood and gold and violent deaths, all enveloped in a haze of sage brush and revolver smoke As a matter of fact such things have not only passed away, but they have passed out of peoples minds in the west, if they are recalled it is in the same way that people in the east recall stories of the Pilgrim Fathers and the Boston Tea Party.

The geographical distinction still remains, but there is no east and west as far as industrial life is concerned The ubiquitous molders foundrymen and molding machine manufacturers have found their way into every place where castings are needed They have built shops, set up their machinery and proceeded to turn out castings in as matter of fact way as any foundry in Boston town where castings have been made almost since the days of Miles Standish Indeed there are foundries not only in Boston but in other old and long established communities which cannot compare either in size, convenience, equipment or output with the Arthur foundry of the Utah Copper Co, located at Garfield, Utah

This shop has increased remarkably in size and production during the past 8½ years In 1910 it was located in a small poorly lighted, and ventilated building 61 x 62 feet, which had been taken over from the Boston Consolidated Co Outgrowing this small building, a new shop was completed in the early part of 1911 which measured 80 x 120 feet The demand for castings for the copper smelters and the building of the Bingham & Garfield railroad increased the work to such an extent that the foundry was extended 75 feet in 1912, 30 feet in 1915 and 90 feet in 1917. At the present time the main building of the foundry covers an area of 80 x 315 feet, after allowing space for the chipping room, coreroom and cupolas there remain approximately 16,000 square feet of molding floor.

The foundry building and equipment is modern in every respect making working conditions ideal. As may be noted in Figs. 1 and 3 light and ventilation have been amply provided for.

At the back of the foundry the iron and coke yard is on a level with the charging floor. Concrete bins are arranged on this yard to hold pig iron, coke, scrap and molding sand. The floor of the bins slope gradually from the railroad track to the charging floor which simplifies to a great extent the unloading of the cars. All the material in the yard is handled by a 20-ton electric locomotive crane. It is equipped with a magnet and besides unloading all the material it

FIG 1—72 x 72-INCH JAR ROLL-OVER PATTERN DRAWING MACHINE EQUIPPED FOR MAKING CASTINGS SHOWN AT *A* NOTE THE SPECIAL TYPE OF STAND AT *B* FOR HOLDING THE CHEEK

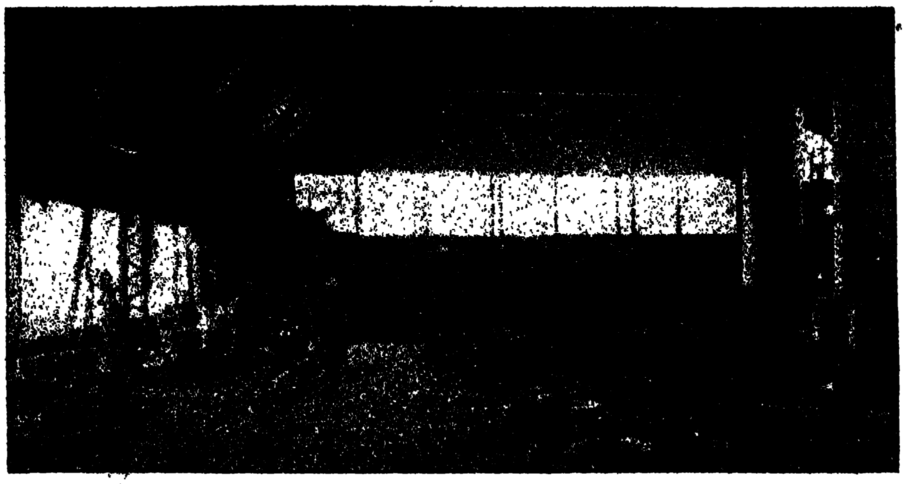


FIG. 2—COKE BUNKER AND CHARGING FLOOR. THE BUNKER IS FILLED WITH COKE THROUGH HATCHWAY IN THE ROOF

handles the drop ball for breaking scrap. Coke is loaded in large boats which the crane dumps into a bunker on the roof of the charging floor. This bunker and the chutes leading down from it are clearly shown in Fig. 2. The crane is also used for removing waste from the chipping room, cupolas, etc.

The brass foundry is located in a separate building from the iron foundry. It is equipped with three oil-fired furnaces having a total capacity of 9000 pounds per day. The brass castings vary in weight from a few ounces to 800 pounds and in quality from plain yellow brass to the best grades of bronze and aluminum alloys.

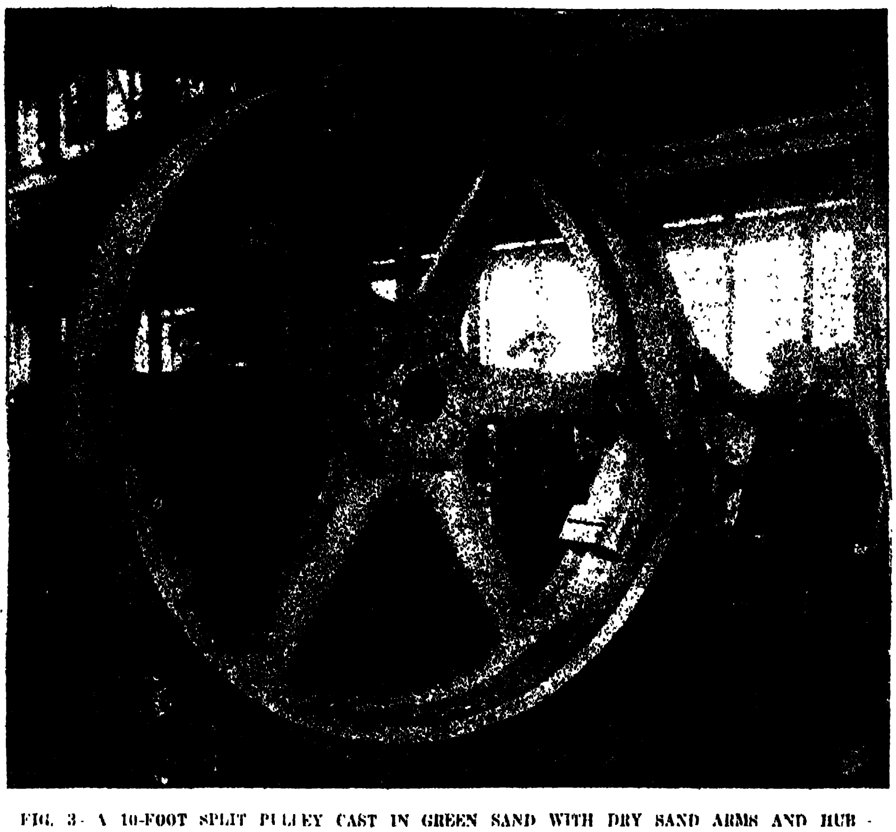


FIG. 3—A 10-FOOT SPLIT PULLEY CAST IN GREEN SAND WITH DRY SAND ARMS AND HUB—T. F. JENNINGS FOUNDRY SUPERINTENDENT AT EXTREME RIGHT

The main bay of the iron foundry is served by two 15-ton electric traveling cranes running the full length of the building. There is a 3-ton electric traveling crane in the side bay and two jib column cranes of 2000 and 3000 pounds capacity, respectively, in the coreroom. There are three core ovens provided for drying the cores, one car oven and two large five-drawer, modern, oil-fired ovens.

The melting equipment in the gray-iron foundry consists of three Whiting cupolas, Nos. 3, 5 and 7. Their combined melting capacity is in excess of 150,000 pounds per heat. The

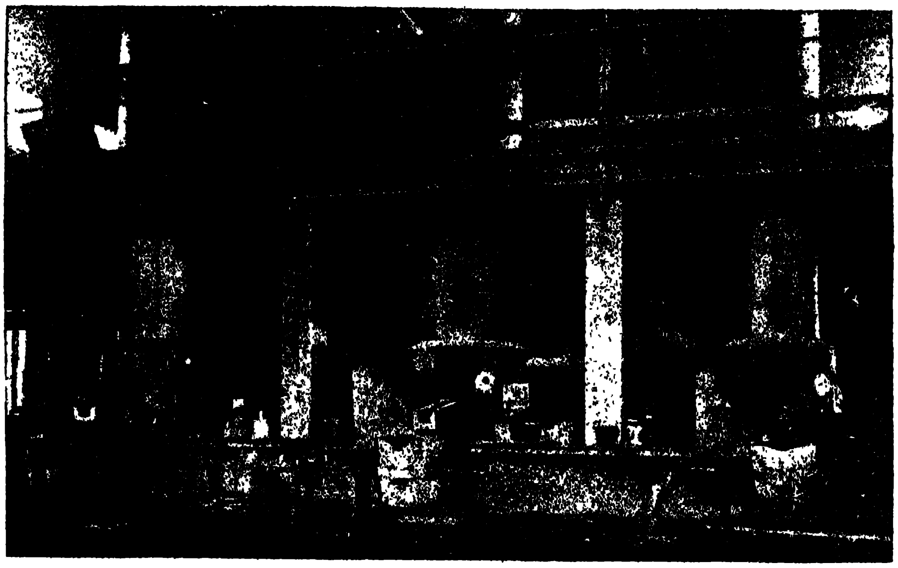


FIG. 4—A BATTERY OF THREE CUPOLAS. NOTE THE CONCRETE WALL ACROSS THE FRONT OF ALL THREE

blast is furnished by three Western Electric centrifugal air compressors and the blast pressure is registered with two Clark blast meters.

The blower room, which [illegible] of concrete, measures 44 x [illegible]. There is a 47-foot wall 4 feet from in front of the cupolas which prevents the drop from spreading around the shop floor. The cinders and shop waste are loaded into large boxes and moved through the end of the shop. When the boxes reach the outside they are loaded on a car by a Link-Belt electric hoist and carried to the dump.

The charging room is built of steel and concrete. The floor has a concrete base with square wooden blocks set on end and wedged with asphaltum. The roof is 20 feet above the floor, and the back wall, which is open for one-half the height, extends the complete length of the charging floor. The general features of the charging floor are clearly shown in Fig. 2.

The molds are made by hand and

also [illegible] molding machines of the latest type. One Herman jar-ram rollover pattern drawing machine, 72 x 72 inches, with pattern, mold and some of the castings produced on it is shown in Fig. 1. There are six other molding machines of various types and sizes used in different parts of the shop. The production of castings has increased from a few thousand pounds per month in 1910 to 1,800,000 pounds in October, 1917.

When the castings are cleaned they are taken from the chipping room on cars which pass over scales where the weight is noted. They are then delivered to the plant machine shop or to the casting stockyard and loading dock from which shipments are made to the various plants of the company. Castings are made of five different grades of metal. Tube mill liners are made of manganese steel.

The working force varies with conditions. It touched the highest point in October, 1917, when a total of 240 men were employed in and around the foundry.

The company operates its own pattern shop. It is 30 x 60 feet with continuous windows around the sides and front. It is provided with eight work benches, six layout boards, two jointers, one band saw, two lathes; one sander, two glue heaters and three trimmers.

In 1916 a new pattern storage was built, 124 feet in length, 64 feet in width and 41 feet high. It is three stories in height and fully equipped with pattern racks throughout. At the present time over 10,000 patterns are stored in this building.

The company's desire for the safety and welfare of the foundry employes is never lost sight of and its accident [illegible]g is remarkably low. There h[illegible]en a serious accident of any k[illegible]r to workmen or equipm[illegible]e past three years.

Local Committees for Foundry Convention at Philadelphia

The convention and exhibition of the American Foundrymen's association at Philadelphia will easily exceed in size and importance any previous affair in the history of the association. A glance at exhibition figures of previous meetings shows that in 1916 at Cleveland 38,000 square feet of space were occupied by the exhibits, 1917 at Boston, 44,000 square feet, and in 1918 at Milwaukee, 42,000 square feet. As early as Aug. 10, 1919, the huge total of 60,000 square feet had already been reserved by exhibitors for this year's big foundry equipment show at Philadelphia.

Special entertainment features also are now being arranged by the local committees with the aim of making the social features of the convention unusually attractive. Thomas Devlin, the veteran president of the Philadelphia Foundrymen's association, is chairman, *ex officio* of all committees, and Howard Evans of the J. W. Paxson Co., Philadelphia, is general secretary.

The members of the various local committees are as follows:

Clearing House Committee

Howard M. Bougher, Chairman, J. W. Paxson Co.
Charles W Asbury, Enterprise Mfg. Co.
H. J. Bannister, George Oldham & Son.
G. H Clamer, Ajax Metal Co.
Stanley G. Flagg III, Stanley G. Flagg & Co.
D. P. Hopkins, U. S. Cast Iron Pipe & Foundry Co.
W. J. Johnson, Baldwin Locomotive Works.
George C. Matlack, William Cramp & Sons Ship & Engine Bldg. Co.
Staunton B. Peck, Link Belt Co.
Charles Suess, Westinghouse Elec. & Mfg. Co.
Walter Wood, R. D. Wood & Co.
Thomas Kaveny, Herman Pneumatic Machine Co
Frank Hodson, Elec. Furnace Construction Co
Silas M. Tomlinson, Frank Samuel.

The chairman of each of the following committees is also a member of this committee.

Information Committee

George F. Pettinos, chairman.
Cyrus Borgner, Cyrus Borgner Co.
W. T. Dunning, Chester Steel Casting Co.
H. A. Ross, Ross-Tacony Crucible Steel Co.
Joseph E. Stutz, Thomas Devlin Mfg. Co.
R. C. Thum, Aetna Foundry Co.
W. G. Summers, Phoenix Iron Co.
W J. Coane, Ajax Metal Co
J. C. Childs, Austin Co.
J H. Schwacke, William Sellers & Co
T. C. Voorhees, Hickman, Williams & Co.

Reception and Hotel Committee

Hon. W. C. Sproul, governor state of Pennsylvania, honorary chairman
Hon. Charles M Schwab, vice chairman, Bethlehem Steel Co.
H. W. Brown, acting chairman, Tabor Mfg. Co
G. H. Clamer, Ajax Metal Co
George C. Davis, Chemist.
E. S. Dailey, William Adams Foundry Co.
Edwin Elliot Midvale Steel & Ordnance Co
J. S. Hibbs, J. W Paxson Co.
W. S. Quigley, Quigley Furnace Specialty Co
W H. Ridgway, C. Ridgway & Sons Co.
W. J. Sherman, Foundry Dept. Bethlehem Steel Co.
E. M. Taggert, J. W. Paxson Co.
C. H. Wollaston, Lobdell Car Wheel Co.

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George C. Davies, chairman, Pilling & Crane Co.
S. J. Creswell, S. J. Creswell Iron Works Co
U. E. Mandell, W. W. Lindsay & Co.
S. W. Mitchell, Philadelphia Roll & Machine Co.
Walter T MacDonald, Fletcher Works, Inc.
C. H. Newcomb, Crocker Brothers
F. J. Ryan, American Metallurgical Co.
George Somerhalder, Westinghouse Elec. & Mfg. Co.
H B. Taylor, George F. Pettinos.
S. R. Vanderbeck, Whiting Foundry Equipment Co.
E. J. Decker, Paul S. Reeves & Son.
Thomas Holt, Camden Foundry Co.
George Fox, Philadelphia Sash Weight Works
F. E. Schwarze, Cleveland Pneumatic Tool Co.
A. G. Hauck, Philadelphia Fire Brick Co.
A. F. Kempe, W. J. Rainey, Coal and Coke.

Publicity Committee

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A. Q. Warren, J. W. Paxson Co.
E. Arthur Bernstein, Bernstein Mfg. Co.
Charles E. McEvoy, H. A. May Foundry Co
George M. Breikert, Fairmount Foundry Co.
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Charles E. Muend, Haines, Jones & Cadbury Co.
J. Harry Mull, William Cramp & Sons Ship & Engine Bldg. Co.
J. T. King, Harbison & Walker Refract. Corp.
E. H. Redmond, Fairmount Foundry Co.
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George R. Sullivan, Rogers, Brown & Co.
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C. K West, General Electric Co.
W. J. Davis, McHatton Foundry Co.
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C. D. Matthews, Camden Iron Works.
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Frank Orem, Federal Steel Foundry Co.
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Wilfred Lewis	C. B White
Charles F. McEvoy	J W. Paxson Co.
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Capt. J. L. Crawford	J. H. Sheeler
W. F. Santer	H. M. Bougher
H. A. White	H. F. Rehmann
Howard Evans	Thomas Devlin
C M Trivett	R. C. Thum
G. H. Clamer	Frank Hodson
Otto W Schaum	F. B. Pitt
F L. Webb	W. H Ridgway
George F. Pettinos	J. H. Golding
M L. Kim	A. G. Warren

Gas Holes in Malleable

By H. E. Diller

Question.—We find small holes, about pea size, in our malleable castings from two patterns. Both castings have the inside cored out with a dry sand core. The cores have a ¼-inch vent which is taken through the cope from the top of a coneshaped print above the core print. Please advise us what we can do to prevent the blow holes.

Answer.—From your description we would judge the trouble is that your cores gather moisture, or that your iron is too low in carbon.

To avoid the first difficulty it would be necessary to be sure the cores are used reasonably soon after they are baked and not allowed to stand in the mold any considerable length of time. Should this not be practical a rosin core could be made which would not take up moisture.

If the trouble is with low carbon in your iron, this will have to be overcome by melting in a less oxidizing atmosphere, which means the use of less air. The carbon is low enough when it is down to 2.50 per cent and care should be taken to see that it does not run much below this in any part of the heat. The writer has seen heats that have been so highly oxidized that, the last iron contained 0.50 per cent less carbon than the first iron.

Institution of British Foundrymen

Report of First Meeting of the Old British Foundrymen's Association Under Its New Name—Papers on Sands, Molds and Patterns Presented—The President's Address Deals With Labor Problems in England

By JOSEPH HORTON

FOR many years the leading organization of foundrymen in the United Kingdom has been known as the British Foundrymen's association. At the sixteenth annual meeting held in Liverpool, July 17 and 18, it was announced that the society hereafter will be called the Institution of British Foundrymen. It also has been decided to apply for a charter of incorporation. About 80 members from all parts of the kingdom were present at the Liverpool convention.

John Little, Manchester, president of the association, occupied the chair during the meeting. Among those present were T. H. Firth, the retiring president: M. Riddell, vice president, and the following past presidents: R. Buchanan, F. J. Cook, W. Mayer and J. Ellis, together with a number of members of the general council. The meeting took place in the Royal Institution, Colquitt street.

The annual report of the council showed a total membership of 1544, compared with 1058 at the time of the previous annual meeting. This is much the largest increase in the history of the association. The establishment of a new branch at Coventry, now having a total membership of 226, is largely responsible for this increase, but all the nine branches show gratifying growth, Birmingham coming second in this respect with an advance from 138 to 189 members. J. E. Hurst, Manchester, was appointed to represent the institute on the British Engineering Standards association's committee on cast iron and will report to the general council. Prof. H. C. H. Carpenter, London; Prof. A. Campion, Glasgow, and Professor Rhead, Manchester, were elected honorary members of the association in recognition of their valuable services to the foundry industry and to the association.

In his address, which was delivered at the opening session, the president, John Little, dwelt largely on the labor question which at present is so vital not only in England but in every country in the world. Attention was called to the temptation for the nation to rest. Mr. Litle said in part:

Rest at this juncture would be fatal to our best interests. It is precisely what the enemy would most like to see. Hostilities in the field are over, thank God, but the fabric, the shattered fabric of our industrial system must be rebuilt, not entirely on the old lines, but rather in accordance with the special requirements of the new era, the dawn of which we have been permitted to witness. Presently we may be able to take things easier. That moment, however, is not yet. Today and tomorrow we must continue the struggle, and upon our ability and determination to do so depends the real victory of the past five years' struggle. We are passing through a phase of industrialism absolutely without parallel. We are in the midst of a revolution, before the mysterious forces of which old ideas cannot stand, and in the economy of which many time-honored methods and institutions are finding no place.

One of the most important problems of reconstruction is that of labor. What can be done to increase the supply of skilled men, and to insure that within a generation the ranks of working foundrymen shall be brought up to the fullest possible strength, every man bearing the hall mark of proficiency? Compared with other sections of the iron and steel industries, molders' wages stand very well indeed. In spite of that, however, there has been for many years, even in prewar days, a danger of lowering the standard of efficiency. What is responsible for this serious state of affairs? In my opinion, and I have been in a position to observe, the trouble begins at the very base. It begins with the system of apprenticeship, or rather, the lack of it.

How many youths and men are there in the foundries today who are scarcely able to write their names legibly, or read a drawing? It is a deplorable state of affairs and cries loudly for rectification. The remedy, I believe, is not far to seek. Let the old system of binding a lad as an apprentice be restored. If possible let him remain at day school until the age of 16 years, but, in any case, as soon as he has become apprenticed arrangements should be made for him to continue his schooling by attending classes a certain portion of each day on his employer's time, with no deduction from his wages. You cannot reasonably expect a lad to leave his day's work in the foundry and of his own free will, passing by his companions on pleasure bent for the evening, commence studies at night classes. Some will do it, and even eagerly in their determination to progress; but they are in a minority, and it is the majority we have to deal with in such a question as this.

Let me once more emphasize the gravity of the question of output. We must preach it in season and out of season. The hope of our industrial future is bound up with it. The output per man must be greatly increased, or we are nationally lost. No reasonable employer disagrees with a man's wage-earning power being increased, nor with the shortening of the hours of labor, but failure to at least maintain the output of this country's shops will play right into the hands of foreign competitors and lead to the ruin of the bright prospects now open to us as a result of the great victory of the allies. It is no use for us to turn our faces from the truth. Labor today is being made the victim of influences which are inimical to the general happiness and prosperity of the nation. We appeal to the uprightness and common sense of the genuine British worker and urge him to awaken to a sense of the actual position of things, to discern between the truth and deception, before it is too late to do either the one or the other.

We have just seen the treaty of peace signed, and now commences a great international fight for trade under reconstructed industrial and commercial conditions. It will require every ounce of energy and sound common sense to pull off a victory, but as certain as night follows day there will be no middle course.

We are in this new campaign for a plain issue, industrial and commercial life or death, and the man, or section of men, neglecting the least opportunity of assisting the country to win is a traitor.

Several papers were read during the conference and each one was thoroughly discussed by a number of members who gave their individual experiences and viewpoints. Prof. P. G. H[illegible]well, Liverpool university, Liverp[illegible] a paper in which he compares [illegible]g sands of Great Britain an[illegible]ca. Professor Boswell's remarks in regard to molding sands, in United States were based largely on his study of American foundries while visiting this country in the fall of 1918 at the request of the British ministry of munitions. This paper brought out a general discussion in which W. Mayer, F. J. Cook, T. H. Firth and President John Little took part. It is published on another page of this issue of THE FOUNDRY.

In reply to questions, Professor Boswell said that he had intended to give a good deal of information as to physical tests, but he had been unable to complete a number of analyses which he commenced last February. He had always held, he said, that chemical analyses of themselves are of little use and foundrymen complain very justly

that such analyses give them no practical information. With regard to sand mills, those used in America are large, with rollers in some cases weighing up to 500 pounds. Dr. Boswell, however, said he is opposed to large mills, and he supported those in the meeting who advocated the general use of small mills. In Belgium, relatively small mills are used with light rollers. It is quite a common practice to have one of the mills fluted, so as to assist in breaking up the sand as completely as possible. Dr. Boswell thinks a small mill, say 2 feet 6 inches by 3 inches, is satisfactory. Although he saw very large mills in the states he never found any reason to favor any of that class of machinery.

In discussing J. E. Hurst's paper on permanent molds and centrifugal castings, S. J. Smith said that in the preparation of the dies, he aims to get a high combined carbon and has found considerable difficulty in getting the metal sufficiently hard. But he has also found that it is possible to get the combined carbon a little too hard for machinability. He said he was very glad to hear from Mr. Hurst that it is possible to produce as many as 2500 castings from a single die, but his own experience is that an average of from 1000 to 1500 nonferrous castings are obtained from a die. He does not think there is a better metal for dies than cast iron. In die casting there is more difficulty in getting away the air from a die than from a sand mold, and special provision must be made for its exit. If a die is found very troublesome in this respect, the best thing to do is to scrap it and make another.

Life of the Mold

[illegible]ook said one of the difficulties a[illegible] regard to the maintenance [illegible]of such articles as small pisto[illegible]s entirely to the life of the mold. About 500 castings represent the capacity of an ordinary permanent mold, probably due to the rapid casting. If a longer time were allowed for casting it might obviate the difficulty, but if only 15 seconds is allowed the mold would become overheated. One of the outstanding features is the size of the grain of the metal of the mold and that is of more importance than the amount of the combined carbon. The silicon content is also very important, because of the breaking up of the pearlite structure. With 1.25 per cent instead of 1.50 per cent silicon, as mentioned by Mr. Hurst, the life of the die is materially improved.

The final paper of the meeting was by H. Sherburn Warrington, on the production of pattern plates for repetition castings. The afternoons were spent in visiting places of interest near Liverpool. On Thursday afternoon, July 17, the works and shipbuilding yards of Messrs. Cammell, Laird & Co., Birkenhead, were inspected at the invitation of the managing director, Sir George Carter. In the evening a dinner was held for the members at the Exchange Station hotel. On Friday afternoon the village and works of Lever Bros., Ltd., Port Sunlight, were visited. There was also an excursion to Southport and some of the members visited one of the Atlantic liners in dock.

Pattern Manufacturers Hold Convention

The second annual convention of the National Association of Pattern Manufacturers was held at the Statler hotel, Buffalo, Aug. 16 and 17. The roll call disclosed the fact that there were representatives present from 26 different branches.

President E. F. Ball delivered the opening address. He said the year just past had been an eventful one and might be referred to as a period of waiting. Before the signing of the armistice, business had been in a more or less chaotic state; and since the armistice had been signed conditions in the pattern making and other fields had not improved to any appreciable extent. He touched on recent labor troubles from the standpoint of the association and made several suggestions and recommendations for their elimination in the future.

A resolution to the effect that the interests of the association would be advanced through the members cultivating a spirit of trust, fairness and co-operation or, in other words, an observance of the golden rule in all their dealings with each other, was adopted unanimously.

At the Saturday afternoon session the convention committee submitted its report. After some discussion it was decided to hold the 1920 convention in Toledo, O., on the second Friday in August and the day following. Several other questions of interest to the association were taken up and disposed of.

The resignation of A. H. Poole as a trustee was accepted and regret expressed that he had found it necessary to sever his official connection with the board.

All the retiring officers were reelected unanimously. The personnel for the ensuing year will be: President, E. F. Ball, Newark Stamping & Foundry Co., Newark, O.; first vice president, Vaughn Reid, City Pattern Works, Detroit; second vice president, J. W. Brost; secretary-treasurer and business manager, E. O. Melville, Melville Bros., Columbus, O.

Trustees were elected for one, two and three years as follows: S. H. Thompson, S. H. Thompson Mfg. Co., Dayton, O., for one year; J. H. Bridge, Maumee Pattern Co., Toledo, O., two years, and A. E. Schuchert, A. E. Schuchert Pattern Works, Cincinnati, three years.

The Buffalo branch provided entertainment for the visitors. On Saturday afternoon the ladies were taken for an automobile ride around the city and environs. At 7 p. m. a banquet was held in the banquet hall of the Statler hotel, at which an address was presented by D. D. Fennell, general manager, Belmont Rubber & Packing Co., Buffalo. The speaker made a strong plea for closer personal relations between employer and employe. On Sunday the party boarded special trolley cars for a sightseeing tour of Niagara Falls.

New England Foundrymen Visit Providence

Nearly 200 members of the New England Foundrymen's association held their annual summer outing on Aug. 13 and were treated to a shore dinner at the Pomham club, Providence, R. I. The association holds outings occasionally for relaxation and for the purpose of having a good time. The entertainment committee provided automobiles to convey visitors from the station to the club which with its grounds and accessories was turned over for the day to the foundrymen. Late in the afternoon, having concluded an informal program of music, etc., the members departed for the West Side club of Providence where further entertainment and refreshments were provided.

Facts About Blowers

Much valuable information on rotary positive blowers, gas exhausters, pumps and vacuum pumps, couplings, blast gates, relief valves, feed devices and governors is contained in a bulletin issued by the P. H. & F. M. Roots Co., Connersville, Ind. Complete tables giving sizes best fitted for various uses with capacity, speed and other data useful to the engineer feature this bulletin. The principle utilized in the impellers and blowers made by this company is clearly set forth. Many illustrations assist in making plain the text.

An alloy for making jewelry consists of gold, 74 parts; platinum, 4 parts and palladium, 21.5 parts. It is similar to platinum in appearance.

Compares Molding Sand Practice

English Geologist and Molding Sand Expert Sent to America During War by Ministry of Munitions Discusses Molding Sands and Foundry Practice of Britain and America

By PROF. P. G. H. BOSWELL

THE writer visited the United States in the fall of 1918 at the request of the British ministry of munitions to make a study of, and report on, the use of molding sands in that country. The saving which might be effected by the use of ideal sands in metal castings amounts to many millions of dollars each year.

The problems involved in the successful founding of iron and nonferrous metals and alloys, such as copper, aluminum, bronzes, brass, light alloys, etc., are due in a less measure to the molding sand used than in the case of steel. The temperatures reached in casting these metals and alloys rarely exceed 1250 degrees Cent., whereas steel might be, and is, frequently run at temperatures approaching 1700 degrees Cent. The foundry practice studied by the writer in the United States and Canada mainly dealt with steel-production; incidentally, iron and brass foundries were visited, especially where they accompanied steel founaries in the same or related works. The following comparison, therefore, deals mainly with steel-production.

A Competent Critic

PROF. P. G. H. BOSWELL, author of this article, is head of the department of geology, University of Liverpool, England. It is in the molding sand field, however, that he enjoys special distinction, having devoted a large portion of his life to a study of sand problems. In this connection he has engaged in much research work and has personally visited many of the world's deposits of sand and studied their individual characteristics and bonding qualities. During the war the British Ministry of Munitions retained Dr. Boswell's services to investigate molding sand practice in British foundries. Later he was sent to America to study the sands of this country. In this paper, which he delivered before the British Foundrymen's association at its annual meeting in Liverpool in July, Dr. Boswell compares American and British sands and discusses the practices in vogue in the two countries.

Rolling Mills Use Steel

The enormous steel output of the United States is largely produced for rolling mills, and stamping and forging shops. It takes, therefore, chiefly the form of plates, sheets, bars, rails, stampings and forgings. The output of castings is considerably less in volume and the steel foundries, like the iron and brass foundries, are often merely adjuncts to the rolling mills and forging shops. In such cases the foundries produce big quantities of wheel-centers, housings, rolls, and other machine parts to replace those which become worn or broken. A large proportion of the work carried out in the remainder of the steel foundries consists of locomotive castings, the upkeep and rapid growth of the extensive transportation systems of America having necessitated the development of numerous big foundries. In many cases the output of the foundry is employed entirely for the works' own use.

Small jobbing shops which turn out castings of a miscellaneous character and often of variable size, appear to be considerably less abundant in America than in Britain. An attempt has been made to standardize and combine a number of these smaller works. It is perhaps early yet to judge of the success of the venture

It is common knowledge that considerably more basic than acid steel is produced in America and the tendency towards the further reduction of the acid output is very marked. Castings are produced from both basic and acid steel, but the output of acid steel castings shows a tonnage about one-third greater than that of basic steel castings. About three-quarters of the tonnage of the steel used for castings is produced in open-hearth furnaces.

Green-sand molding is much less common in America than in Britain, and is reserved for small work. It is more frequently practiced in the Middle West than in the Eastern states. The unwillingness to make green-sand castings might be attributed to the sands used, which are perhaps more suitable for dry-sand work. It would, however, be difficult to sustain this objection, and, in short, it is the opinion of the writer that American green-sand molding falls, in the matter of foundry technique, behind the British practice.

Types of Molding Sands

The sands used for the casting of iron, brass, etc., require and receive only incidental attention. Erith (or Thames) sand was actually imported, though quite needlessly, into America before the war. The famous sand from Albany, N. Y., is strikingly similar to Erith sand in analysis, texture and behavior, and like the latter, is used in the casting of iron, bronze and brass. For heavy iron castings, local sands of fairly coarse grade are utilized. One of the most popular, in the Eastern states is that from near Millville, N. J., known as "New Jersey gravel." Others, also from the same state, used for the casting of brass, are known as Lumberton and Howall sands respectively. Cores are prepared for brasswork from a fine silica sand such as that worked for glass-making in Pennsylvania, bonded with oil. None of the above mentioned sands are sufficiently refractory for steel-casting, and most of th[illegible] are also unsuitable in grade.

No sands are found in [illegible] States similar to our wide[illegible] valuable deposits of Bunter age (Birmingham, Kidderminster, Mansfield Wolverhampton, Stourport, etc.), which are the backbone of our foundry sand industry, so far as iron, brass, etc., are concerned. These sands have a markedly rich red color, resulting from the ferruginous bond, and also possess characteristic chemical and mechanical constitution.

Molding-sands used for the casting of steel may be divided roughly into two classes:

(*a*) Those in which the natural clay bond is sufficiently strong in itself for foundry purposes;

(*b*) Those requiring the addition of fireclay and some artificial bond, such as molasses, flour, dextrin, oil, etc., to yield a strong structure.

Throughout the British area, the

sands used are almost without exception those falling into the first class. On the other hand, the practice most widely adopted in America is to use artificially bonded silicia sands. Only in the Eastern states, where supplies of naturally-bonded steel-molding sands are found in New Jersey, is the practice similar to our own. Even in New Jersey no sands have been found which carry a bond so strong or so highly ferruginous as that of our high-class western European molding-sands such as Belgian red, Belgian yellow, French red, French yellow, etc.

Excluding certain scattered and relatively less important foundries, we may group steel-founding in the United States into three chief areas:

(*a*) The Middle West, the chief centers of which are Milwaukee, Chicago and St. Louis. High-silica sands, artificially bonded, are used exclusively in this region.

(*b*) The Ohio-Pittsburgh area, where sands from Ohio and Pennsylvania are mainly used. The sands are high-silica sands, but are not so pure as those used further west. They carry a slight natural bond, but not sufficient to bring the silica content below 95 per cent. Artificial bonds are necessary to give them the required consistency and strength.

(*c*) The Eastern seaboard, including particularly the areas around Philadelphia, New York, and Boston. In the matter of the sands used, Montreal and Nova Scotia may be considered to lie in this belt. The molding sand employed is almost exclusively New Jersey sand, which has a moderately strong natural bond. The silica percentage is much higher, however, and the alumina percentage lower than those of British used materials (SiO_2, 80 to 89 per cent; Al_2O_3, 4 to 9 per cent). The sands are less ferruginous, the smaller percentages of ferric oxide and alumina accounting for the weaker bond. Occasionally the New Jersey sands are used in the American foundries without the addition of an artificial bond, but in most cases molasses, flour, dextrin or other compounds are added to the sand.

New Jersey sands are also transported to the Pittsburgh area mentioned under (*b*) above, but their use is not extensive in that area on account of the high expense of transporting them.

The outstanding difference in practice on the two sides of the Atlantic, therefore, hinges upon the use of artificially bonded high silica sands. Among the sands most extensively employed for this purpose are the well known deposits worked for glassmaking, abrasive and other purposes by many companies near Ottawa, Ill. To a much smaller extent, other sands, such as those from Pacific, Mo., northern Pennsylvahia, etc., are used.

The Ottawa sand is white or pale-

Comparison of Naturally and Artificially Bonded Sands

1.—A better finish is obtained upon the castings, especially if the bond is ferruginous, when a sound, smooth, blue skin is obtained. The casting strips freely even when hot.

2.—In the present practice fewer troubles, like scabs, blowholes, and burning-on are experienced.

3.—The bond is stronger when wet.

4.—The sand is not easily standardized and made fool proof. It is liable to considerable variation in the field, and consignments often differ in composition.

A skilled workman is required at the mill to mix the sands properly, to keep the composition constant, and to mill the product for the correct period of time.

5.—More delicacy is possible in the variation of the composition of mixtures according to the classes of work in the foundry (e.g., as many as seven types of molding mixtures may be made.)

6.—On the other hand, too many constituents for [illegible] work are often present in the mixtures. The number is frequently four and sometimes reaches five.

7.—In the chemical analyses of material of different grades present, the sand-grade or high-silica portion is not so refractory as a natural high quality silica sand. The clay grade also is less refractory than the highest quality fireclays.

8.—The fine sand, superfine sand and silt are not absent, although in the best sands the proportion is low.

9.—The best molding sands carry considerable quantities of colloidal hydrated iron oxide. This compound improves the bond and life of the sand and assists the stripping and soundness of the casting. (See 1, above.)

10.—Reclaiming of sand is not easy owing to the considerable quantity of burnt clay present. Less old floor sand can be used in the mixture.

11.—The available quantities of naturally bonded sands in Britain are (excepting the less well bonded Scottish rotten-rocks) strictly limited. The reserves of foreign sands are also inadequate; in any case, we ought to be independent of them. The best known naturally bonded sand is from Belgium.

Artificially Bonded Sands

1.—The finish is rougher, the surface of the casting having a gray color and frequently being pitted.

2.—At present, trouble is caused over scabbing and blowholes.

3.—The bond is weaker until the mold is dried. working is therefore not so easy, and molds left standing are more easily damaged.

4.—The molding sand is easily standardised and the method practically fool proof. High silica sands almost always run true to sample, as do also the fireclays used. In any case, the quantity of the latter is small.

Unskilled labor can be employed at the mill, and the mixture milled for a given time.

5.—Less adaptability is shown to different kinds of work.

6.—The molding mixture is generally composed of two materials, together with an artificial bond. Rarely, three are used.

7.—Both high silica sand and fireclay may be chosen for their chemical composition and exceptional refractoriness to heat.

8.—The venting is improved if the separate sand and clay are so selected that silt and fine sand are absent.

9.—Colloidal hydrated ferric oxide is practically absent. The bond is therefore weaker and the skin of the casting less good. Stripping is more difficult.

10.—The artificial bond burns out, and the amount of fireclay which is calcined is small. A little fireclay is thus sufficient to restore the sand. As much as 80 per cent of floor sand can be used in a new mixture.

11.—The available quantities of high silica sands and fireclays are practically unlimited, both in the United States and Britain. Independence of foreign supplies is assured. British resources are as high in quality as those from abroad.

colored, a chemical analysis of an average sample being as follows:

	Per cent
SiO_2	98.47
Al_2O_3	0.75
Fe_2O_3	0.08
MgO	0.08
CaO	0.21
K_2O	0.06
Na_2O	none
TiO_2	0.05
Loss on ignition	0.47
Total	100.17

The chemical composition of the slime washed from the sand is as follows:

	Per cent
SiO_2	87.21
Al_2O_3	7.50
Fe_2O_3	0.52
MgO	none
CaO	none
Na_2O and K_2O	0.20
	95 43

Remainder mainly water

The chemical analysis shows the sand to be highly refractory to heat, for the silica content is very high and the proportion of alkalies and alkaline earths very low.

The importance of the grade of a molding-sand cannot be over estimated (see "British Resources of Refractory Sands.") The Ottawa sand is well graded and consists mainly of the medium sand grade.

Siliceous Fireclay Employed

The relatively large quantity of material in the coarser grades and the small amount of silt and clay, insure open and well vented sands.

Other silica sands employed in the same way occur at Massillon, O., Phalanx, O., Utica, N. Y., Franklin, Pa., and Millville, N. J. Several of these carry also a small quantity of clay and ferruginous bonding material, which at times reduces their silica percentage to 95 or 96 per cent. Chemical analyses of the Portage and Massillon sands in terms of percentages are:

	Portage Per cent	Massilon Per cent
SiO_2	98.30	96 27
Al_2O_3	0.59	1 70
Fe_2O_3	0.53	0.55
MgO	0.10	0.11
CaO	0.16	0.16
Na_2O	0.04	0 07
K_2O	0.18	0.38
TiO_2	trace	0.12
Loss on ignition	0.12	0.83
Totals	100 32	100 19

Besides the artificial bond, which in most cases is molasses, and less frequently flour, sulphite-lees, or dextrin, a siliceous fireclay is usually added to the silica sands mentioned above. Only a small quantity of this binding clay is necessary, the proportion generally varying from 3 to 7 per cent. The addition of fireclay necessarily lowers the refractoriness of the sand, whereas the presence of the molasses, dextrin, etc., makes no difference. As small a quantity of clay as possible is, therefore, used, and in order that the binding quality may be a maximum, the clay selected is as plastic as possible, consistently with being highly refractory.

One of the most popular bonding clays in use in the Pittsburgh district and on the Eastern seaboard is that from Welsh mountain, Pennsylvania. It is a cream colored or yellowish fireclay, having the following chemical composition:

	Per cent
SiO_2	62.50
Al_2O_3	21.46
Fe_2O_3	1.74
FeO	1.20
MgO	1.13
CaO	0.14
Na_2O	0.19
K_2O	4 28
H_2O +	5.81
H_2O	0.61
TiO_2	1.04
P_2O_5	trace
CO_2	none
MnO	trace
BaO	trace
Ce	trace
Loss on ignition	....
Total	100.19

Fireclays from Illinois are similarly used in the Chicago-St Louis area for bonding purposes. Some of the fireclay seen in the works was so siliceous as to resemble our Scottish "rotten rocks."

The clays are ground to pass through 80-mesh screens before being supplied to the steelworks. They are then added to the sand in the desired proportion and ground for a few minutes with the addition of molasses and water, in a pan mill, the procedure being in that respect similar to our own, but the time of milling being less. The molding mixture when taken from the mill is much less tough than our naturally bonded sands, for the full effect of the artificial binder is not seen until the mold dries. In certain cases no artificial binder is added in the mill; the sand and clay are ground together with water, and the face of the mold when made is washed over with molasses or dextrin water. Molasses water is used in preference to flour or dextrin on account of its lower cost.

The American practice in regard to naturally bonded molding sands does not differ very appreciably from ours. The use of such sands is, however, much more limited. The sands from Portage and Massillon, O., bear a slight bond, but it cannot be compared in strength with that of western European sands. Practically speaking the only naturally bonded sands worked in America are those of New Jersey. The binding material in them is clayey, but not strongly ferruginous; it is therefore less strong than that of Belgian, French or British materials. The bonded sand is milled alone or with a high silica sand in a pan mill. In some works an artificial bond is also added, in other cases a fireclay such as Welsh mountain silica clay is mixed with the sand. The resulting product, in any case, does not attain such a tough condition as that of British sands.

The fat sand, from Messrs. Paxson & Co.'s quarries at Millville, N. J., has the following composition:

	Per cent
SiO_2	82.14
Al_2O_3	8.90
Fe_2O_3	2.15
FeO	0.14
MgO	0.31
CaO	0.19
Na_2O	0.10
K_2O	1.22
TiO_2	0.86
H_2O +	3 03
H_2O −	1.16
Total	100.19

In many respects the Scottish practice of using "rotten rocks," the bond of which is often assisted by the addition of treacle, flour, etc., may be considered as intermediate between the English practice of using natural strongly bonded sands, and the American practice of using high silica sands cemented by fireclay and an organic binder. The Scottish rotten-rocks are soft sandstones largely composed of quartz, but carrying also a certain proportion of micaceous and china-clay products, which have resulted from the decomposition of feldspar grains once present in the rock. The clayey material provides a certain amount of bond, but as it is insufficiently strong, the rock is milled with a small quantity of fireclay and sometimes an organic binding material. In most cases the latter is diluted treacle. It is noteworthy that, as in America, steel-castings made in these sands possess a gray skin and do not strip so freely or readily as those made with facing sands carrying a ferruginous bond.

Core Making Practi[illegible]

Coal or sawdust is o[illegible]s[illegible] used, in the same manner as [illegible], for opening up and venting a steel molding sand. The use of either material is not widespread, venting being generally obtained by the admixture of coarser high silica sand.

The practice in coremaking varies in the United States as it does in Britain. In some cases a high silica sand bonded with oil is used, in others the bond is rosin. Silica flour was often added to the core mixture, and a sand for use between the teeth of wheels consists similarly of a mixture of high silica sand and silica flour. The "flour" was prepared by grinding either a pure silica sand, *e.g.*, Ottawa, or a pure quartzite, *e.g.*, Wisconsin.

Silica flour in varying quantities up

to 1 or 2 per cent is sometimes also added to the ordinary molding sand in the pan mill. The casting probably skins more freely from the molding sand as a result of this procedure, and the refractoriness of the sand is obviously increased. The facing sand of cores is occasionally prepared with a much larger quantity of silica flour in the core sand, with the object of reducing "burning-on" as far as possible. It should be remembered that the silica flour is ground to a fineness which yields a certain amount of plasticity and bonding power. The admixture of china clay (kaolin) with molding sands was nowhere observed.

The quantity of old floor sand used in molding sand mixtures varies from nothing to 80 per cent. The latter quantity is higher than in the British practice, where 50 per cent may be taken as a maximum. The use of a greater quantity of old sand reduces costs appreciably, but it is probably related to the character of the sand. The artificial bond burns out, the burnt clay rubs away in part, and a small quantity only of fireclay is sufficient to "revive" it.

Use of Composition

The "compo" or composition of the British steel-founder, made from a mixture of broken crucibles, firebricks, sand, crushed quartzite, coke, graphite, etc., and used for large castings, is unknown in America. A similar product is, however, used in iron molding. Large steel castings are prepared in molds made from the same sands as small ones, but the composition is altered as required. Usually the bond is made somewhat stronger and silica flour is added to maintain the refractoriness. Castings weighing as much as [illegible] pounds are thus made.

[illegible]est British practice small m[illegible] not painted, and the surface[illegible]arge ones are washed over with either "silica-paint" or a wash prepared by mixing compo with water and allowing the coarse material to settle. In the United States silica paint only is used, and most frequently molds of all sizes are painted. Painting is supposed to insure the production of a good skin upon the castings, and easy stripping from the sand. In the case of small castings, it is a matter of opinion whether paint assists the stripping by preventing burning-on of the sand, or is conducive to soundness in the casting. In America silica paint is generally prepared as a viscous fluid from silica flour and water with the addition of molasses, flour, glutrine and in some cases common salt. Silica flour alone is sometimes dusted over the mold. The use of tar as a paint on large molds has almost died out in Britain, and was nowhere observed in America.

The nails used in sprigging the molds in American foundries are much larger than those employed in Britain. They are also used much more extensively. Sometimes the mold is studded with them. Apart from strengthening the structure, they also serve to conduct away the heat, but their excessive use seems to be undesirable and expensive. It may, however, be related to the weakness of the bond, as compared with that of European sands.

The venting of American sands does not appear, in most cases, to be so thoroughly accomplished as at home. In the case of the naturally bonded sands in the Eastern states, the grain of the sand grade in the natural mixture is smaller than that of Belgian and British sands. More need, therefore, exists for the opening up of New Jersey sand with coarse silica sands. In the few works where effective venting is secured, the improvement in soundness of the castings becomes evident.

The arguments adduced in favor of the practice of using artificially bonded silica sands are such that the writer is inclined to recommend the more extensive use of what might be termed synthetic steel molding sands. In order, however, to retain the excellent bond and stripping power of the sands, and the consequent good skin of the castings, it will be desirable to discover and use natural supplies of colloidal hydrated iron oxide (ochre) or compounds with similar physical characteristics. Here are problems for laboratory investigation and works experiments. Such an opportunity for standardization should not be ignored, but, on the other hand, the difficulties of the problem should not be underestimated.

More Standardization Desired

The introduction of repetition work into a foundry saves both time and labor, and increases production. It is evident that while it may not be feasible to standardize a number of foundries scattered over the country, using, perhaps, somewhat different materials, and faced by differing local labor conditions, yet there is room for a greater amount of standardization in each individual foundry. The introduction of far more molding and ramming machines into the foundry is a case in point. Molding sand practice leads itself to experimenting upon these lines, but there is a limit to the uniformity attainable, for it would be deplorable if anything were done to reduce the individualism of the trained foundryman—his skill, predilections, experience and traditions, and it is in this direction that the writer feels that the British foundryman is still ahead of his American brother. Prejudice must not be allowed to reduce this lead. The smaller individual output, not always due to more thorough work, threatens seriou[illegible] it. This is doubly [illegible] view of the fact that the most urgent question facing the foundry industry is the speeding up and increasing of production in every department.

In conclusion, the writer gladly takes this opportunity of recording his thanks to the numerous American gentlemen who gave him such a cordial reception and opened their works to him without reserve. It is to be hoped that American visitors to Britain will in the future be accorded at least the same facilities, and as hearty a welcome.

Move Head Office to New York

The Chicago Pneumatic Tool Co. plans moving its general offices from Chicago to New York and toward this end is erecting an office building at 6-8 East Forty-fourth street, New York City.

The structure, which is being built by the Westinghouse Church Kerr Co., New York, is of combination steel, brick, and limestone, and will comprise initially 10 stories, all to be occupied by the company.

The operation of the company's six American plants and 26 sales and service branches can be directed more economically from New York. There will be continued in Chicago a sales and service organization more extensive than formerly. The new building is to be ready for occupancy early in 1920, at which time the transfer will be effected.

The T. W. Price Engineering Co., Woolworth building, New York, is engaged in making plans for a large foundry for making cast iron pipe by the new process known as the "centrifugal cast iron pipe process," which has proved successful in an installation at the plant of the National Iron Works, Toronto, Can.

A soldering paste for use in soldering aluminum, patented by H. C. Proctor, consists of powdered rosin, 75 per cent; vaseline 20 per cent and ammonia, 5 per cent.

Molds Made by Centrifugal Method

In Order to Attain Maximum Efficiency it is Necessary That Molds be of Sufficiently Heavy Section That Repeated Use Will Not Bring Them to Red Heat

By J. E. HURST

AS a result of the desire to avoid the destruction of the mold after the completion of each casting, permanent molds of various types are employed.

The system of pressure die casting is not being applied commercially to ferrous castings, and the author is not aware of any extensive experiments in this connection. The production of castings in cast iron by the centrifugal process, however, might be classified under the heading of pressure die-casting.

It is the author's experience that the occurrence of pinholes in cast iron die castings made in stationary dies is entirely a question of the temperature of both the metal and the die, and is not influenced by the cast-iron die unless, of course, this is in a very badly disintegrated state.

In certain circumstances cast-iron dies have been known to crack after being in use for a very short time. In these cases the cracking can for the most part be traced to defective design of the dies, and also to the presence of internal defects such as blowholes and porosity in the die material. Defective design resulting in the production of uneven internal stresses is more frequently met with in dies of complicated design. Apart from such cases the failure of dies takes place by a peculiar form of surface cracking and disintegration, which ultimately results in the complete fracture of the die.

The rapidity of the initial formation of surface cracking in dies depends entirely on the maximum temperature attained by the die in use. Growth commences at temperatures of from 650 degrees to 700 degrees Cent., or at quite a red heat. If the dies are allowed to attain this temperature the surface growth will rapidly take place. It is necessary, therefore, to have the dies sufficiently thick in order to prevent this temperature being regularly obtained under the particular conditions and rate of casting in vogue.

Messrs. Rix and Whittaker, as a result of their experience with aluminum-bronze die-castings, in which the die temperatures attained are quite comparable with those of cast iron, state that the life of dies in their practice was approximately 5000 castings.

Distortion troubles also can frequently be attributed to defective design of the die, resulting in the heat producing internal stresses, setting up the strains which ultimately result in the permanent distortion, and frequently cracking of the dies as noted.

Apart from the effort of bad design, permanent distortion in the mold appears to be due to the gradual decomposition of the combined carbon. The internal stresses set up as a result of the volume changes result in the gradual permanent distortion of the mold.

The best method, in the author's experience, of reducing these troubles to a minimum is the use of an iron with an extremely low combined carbon content.

In the production of the die blocks of cast iron, closeness of grain is quite an essential feature, as this tends to minimize the rapidity of surface growth. The production of very low combined carbon material, at the same time accompanied by a very close grain, is frequently a difficult matter, particularly in thick dies cast in sand. The use of chilled molds is therefore advisable for the production of cast-iron die-blocks of low combined carbon.

The temperature to which the die is subjected appears to have little ultimate influence on the distortion as whatever the temperature the combined carbon content is ultimately decomposed, particularly if the silicon is in excess of 1.5 per cent.

Iron castings made by the centrifugal method of casting might be considered as belonging to the die-castings class. For many reasons, however, it is preferable to consider such castings as belonging to a separate class, and the author prefers the distinguishing title of centrifugal castings.

In the centrifugal process, castings are produced by introducing the molten metal into a metal die, or permanent mold, which is rotated at a high speed. The molten metal takes the required form of the mold as a result of the centrifugal action due to the high speed of rotation.

Most castings having a cylindrical internal form can be produced by this process. The external form need not necessarily be strictly cylindrical, and castings having considerable variations in the shape of lugs, projections, and fins on the external face can be produced by this process.

Some of the advantages of the centrifugal process over ordinary die and sand castings are said to include: Absence of gates, runners, risers and feeder heads; the entire absence of cores; the ease and rapidity of production; the absence of necessity for cleaning.

Die-cast iron castings possess distinct advantages over ordinary sand castings, in the author's opinion. The foremost advantage is undoubtedly the extremely fine grain size.

The grain size of any fine composition cast iron is, generally speaking, a function of the rate of cooling. The more rapid the rate of cooling the smaller the grain size. By the use of metal dies the rate of cooling of the cast iron is considerably increased, with a resulting increase in the fineness of the grain. The obvious danger is the possibility of the rate of cooling being sufficiently fast for chilling to take place, [illegible] the castings a hard unmachi[illegible] [illegible]te-iron skin. This, howev[illegible] be avoided by a suitable ad[illegible]s of the composition of the iron, the thickness of the mold, and the temperature of the metal and mold before pouring.

The foundry, as an occupation for a large majority of our brainy youths, is very frequently passed over as being a "filthy job." This is due largely to the employment of sand as a molding material. From an aesthetic standpoint alone, therefore, the more extended use of permanent molds or dies is warranted, and it seems certain that this would assist in the future development of the craft.

Abstract of paper presented at the July, 1919, annual conference, British Foundrymen's association, Liverpool, England.

The Lumen Bearing Co., Buffalo, expects soon to build a plant at Youngstown, O., where mill bearings and other heavy brass castings will be made to supply increasing demand.

Castings for Ship Construction—IX

Suggestions For a Different Design in a Standard Propeller-Bracket Pattern Are Offered, and Full Details Concerning the Building up of Barrel, Arms and Palms are Presented

By BEN SHAW and JAMES EDGAR

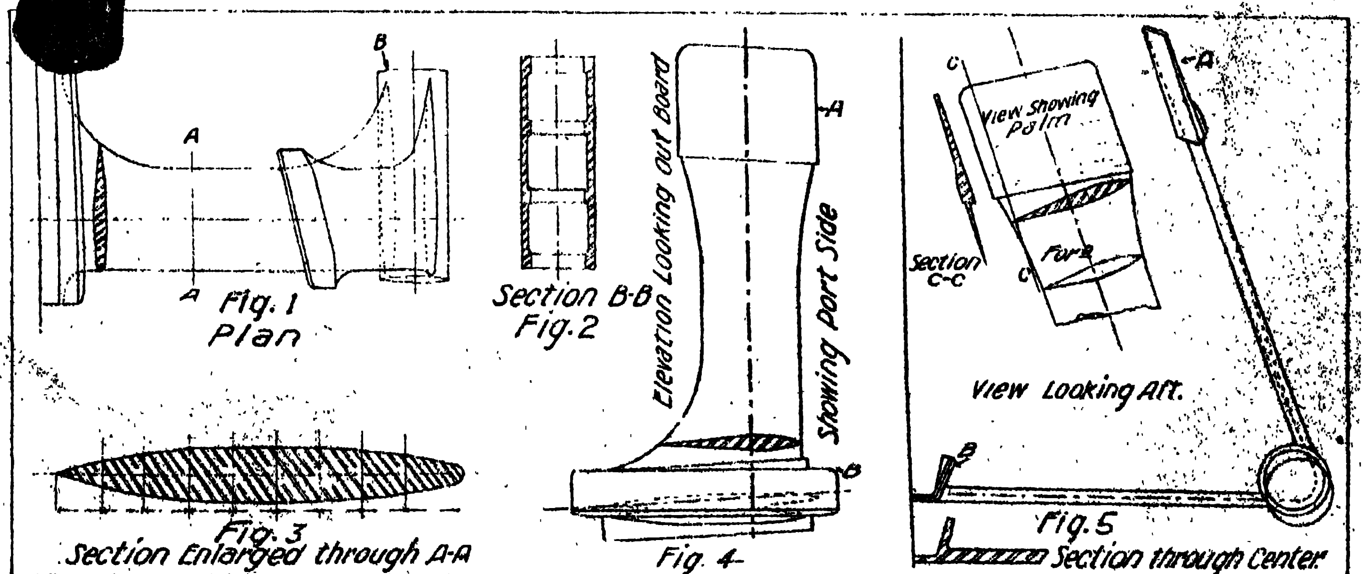
ALTHOUGH the design of the propeller bracket shown in Figs. 1 to 5, resembles in some respects the one described in the previous article, it differs in some important details. The section of the arms or fishbacks is the same in both cases, except that in the bracket under consideration they are not cored out, but are cast solid. These brackets sometimes are called A-frames, because of their shape. It will be observed that the boss in this case is long, and the palms are, of course, quite different. It might be possible to make the pattern for this bracket in a similar way to the one already described, that is, by building two mocks on the floor, fitting the arms between them and the boss, after the palms are finished. But this would be a clumsy task. It would be difficult to secure accuracy, or to get a job sufficiently strong to withstand the wear and tear in the foundry.

It is possible to build this bracket in a position corresponding to that which it will take in the ship. The construction of the pattern requires great care, because of the angles of the arms in relation to the boss, and the angles of the palms in relation to the arms. It would be inadvisable, even with the most careful workmen, to allow a bracket pattern to go to the foundry without a careful examination. An idea of the difficulty of making the bracket pattern is obtained when it is pointed out that the barrel for the boss is sometimes 25 feet long.

Sketches of the templates supplied by the molding loft are not given, because they are similar to those for the propeller bracket described in the previous article. A template is made for the arm section. In this case the arm does not taper in thickness toward the palm, but is of uniform section throughout. The angle of the boss is given by a template. This rectifies any discrepancy between the drawing and ship. A template also is necessary for both shape and angles of the palms, while a large template defines the angles of the arms to each other. It is not necessary to set the job out in full on the floor. The better way is to make full size views of each arm on a drawing board, and either set out center lines of arms and boss on a drawing board or on the floor. It is necessary in order to economize when getting out lumber, to make scrap views of fillets, palms and parts of the barrel. As only the best lumber can be used on such work the importance of economizing is great.

The boss for this bracket is long so it is necessary to provide two lifting bolts and the stays (A, Fig. 6) should be made about three inches thick, and four or five inches wide. The lumber should be placed perfectly straight, for if it is warped in the length it will be impossible to make a true barrel. It is good practice to get out all the timber for such a job at the beginning, cutting it to approximately correct widths and thicknesses. Even a comparatively straight grained board will change its shape when reduced in thickness or cut into widths. But if cut to the correct thicknesses and widths, and allowed to lie for a day before being planed it will be less subject to distortion. In some patternshops this is the charge hand's work, after he has set down the job, and apart from the saving in lumber it compels him to master the details of the job thoroughly at the beginning. It is not possible, however, to adopt this practice with some jobs, where every piece of lumber has to be cut separately and fitted. The rings or grounds should not be more than 20 inches apart. As the lifting bolts—usually 1¼-inch bolts—will drop down toward the outside of the barrel, special stays like *B*, Fig. 6, should be checked into the rings. These form guides for the bolts.

It is not well when making such a heavy barrel to rely on the stays



FIGS. 1, 2 AND 3—PLAN AND SECTIONS OF TYPE OF PATTERN FOR A PROPELLER BRACKET FIG. 4—ELEVATION OF PATTERN FOR PROPELLER BRACKET, LOOKING OUTBOARD FIG. 5—VIEW LOOKING AFT, WITH DETAIL OF PALM

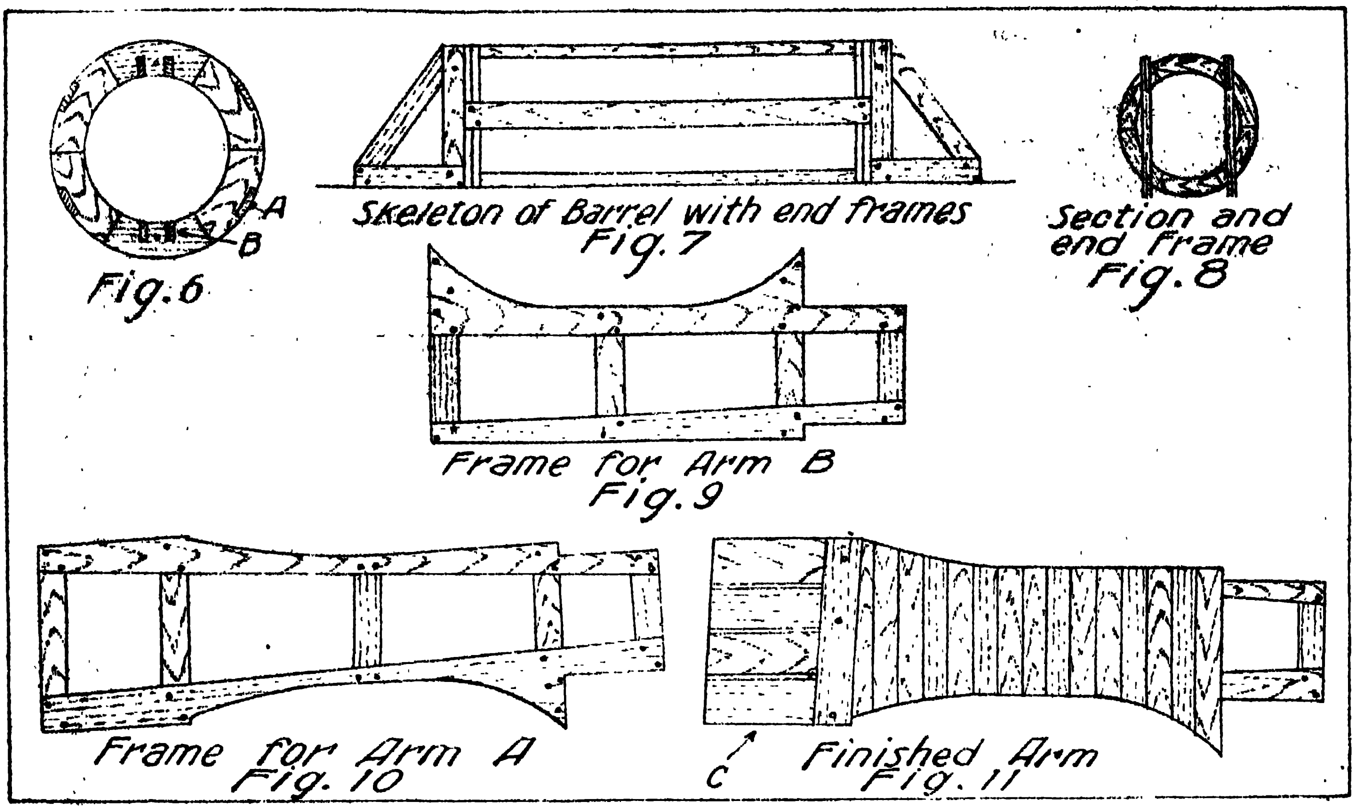
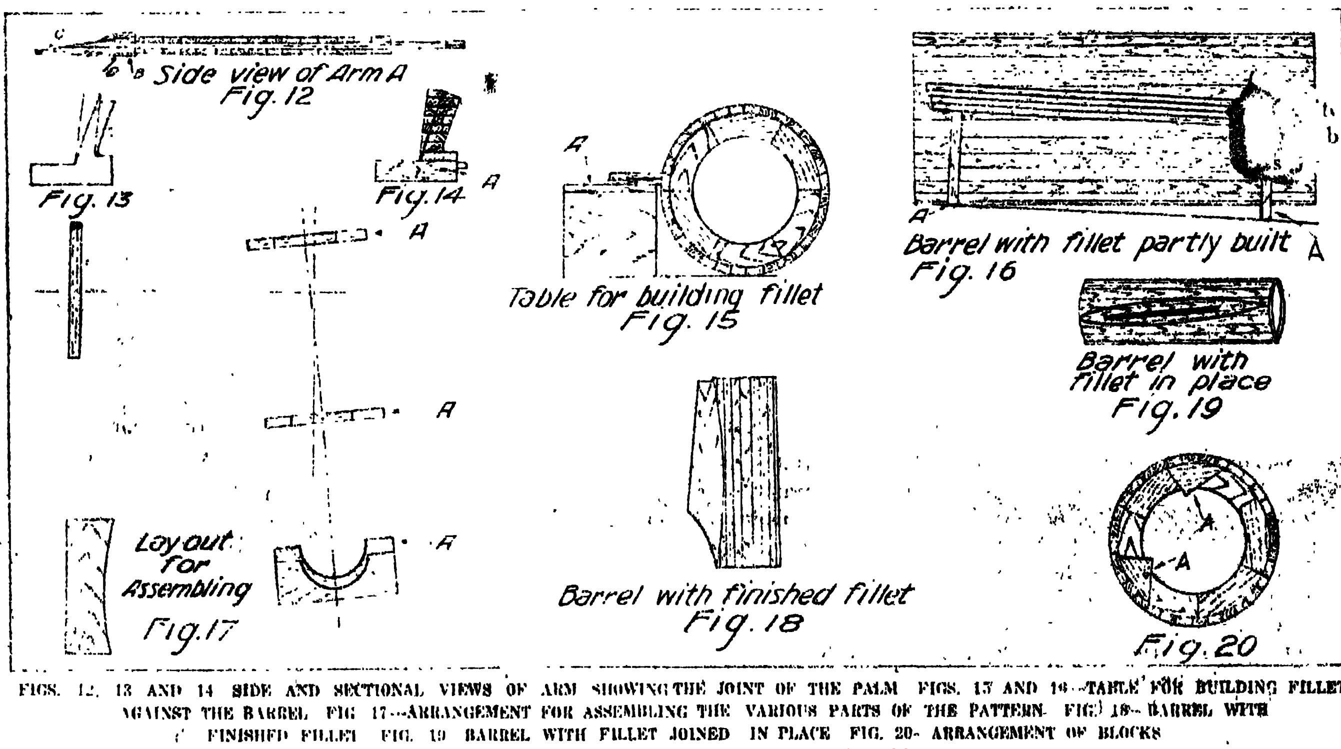


FIG. 6—BOSS FOR PROPELLER BRACKET PATTERN, SHOWING THE LIFTING BOLTS. FIG. 7—SKELETON OF BARREL WITH END FRAMES. FIG. 8—END VIEW OF SKELETON BARREL SHOWING END FRAMES. FIG. 9—FRAME FOR ARM *B*. FIG. 10—FRAME FOR ARM *A*. FIG. 11—FINISHED ARM

while fastening the lagging. Cross center-lines should be drawn on the rings, and the skeleton fixed on the floor with end triangular frames, Figs. 7 and 8. It is a simple matter to screw straight edges across the center lines on each end, on which to try a level. It is necessary, of course, to pack one end ring underneath, as each ring is of a different diameter owing to the taper of the barrel. A few diagonal stays usually are fitted inside the skeleton between the rings before the lagging, which ought to be 1½ inch or 2 inches thick, is screwed on. The lagging for such a job should be open jointed. When half of the barrel has been covered with the lagging, the triangular frames can be safely removed and the remainder of the lagging fixed. The frames for the arms, Figs. 9 and 10, differ from each other because the palm *A* in Figs. 1, 4 and 5, is built on the center frame, while the palm *B* is made separately and dowelled on. The fillets would be too un-



FIGS. 12, 13 AND 14—SIDE AND SECTIONAL VIEWS OF ARM SHOWING THE JOINT OF THE PALM. FIGS. 15 AND 16—TABLE FOR BUILDING FILLET AGAINST THE BARREL. FIG. 17—ARRANGEMENT FOR ASSEMBLING THE VARIOUS PARTS OF THE PATTERN. FIG. 18—BARREL WITH FINISHED FILLET. FIG. 19—BARREL WITH FILLET JOINED IN PLACE. FIG. 20—ARRANGEMENT OF BLOCKS INSIDE THE BARREL FORMING SQUARE FACES FOR NUTS

wieldy if completed separately from the arms. A better way is to form part of the fillet on the arm. The arms should be fixed by hook bolts, the hooks gripping the frame of the arms, and the bolt penetrating to the inside of the barrel. Of course a guide has to be formed for the arm, and this is done by making the frame act as a dowel into a recess in the fillet. The center frames should be stoutly made. The portion at the boss end forming the dowel should be the depth of the part of the fillet which is fastened on the boss. This should be a foot or more, depending on the length of the arm.

The best way to build the arms is to screw pieces across the frame, apart are set down on it, 1-inch lumber can be used for constructing it, and each thickness finished, before it is fastened on. This is both a quicker and more accurate method than building lumber roughly and shaping it finally. The face *A*, Fig. 14, which joins the arm, has to be planed so that the angle of the palm will be correct. Care must be taken also when inserting the dowels. If centers are drawn on each face, there should be no difficulty. It is necessary to trim the edges when the palm is dowelled on. This will have to be screwed as well as dowelled to keep it rigidly in position while the molder is ramming sand around it.

Building the fillet is the most arduous task of all. It has to be built rel is set down on the floor, and a line corresponding to the face of the fillet is also drawn with the center line of the arm bisecting it, the barrel will have to be lifted on saddle pieces so that the fillet can be built with a level center. This is necessary because the cross centers of the arms are not on the same plane as the horizontal center of the boss. Fig. 17, which shows the arrangement for finally assembling the various parts will give the arrangement for building the fillet. The saddle pieces are first screwed down, and the barrel rested on them and retained in position by screws or battens on the ends. A table, *A* Figs. 15 and 16, has to be made for building the top part of the fillet, and the first piece of

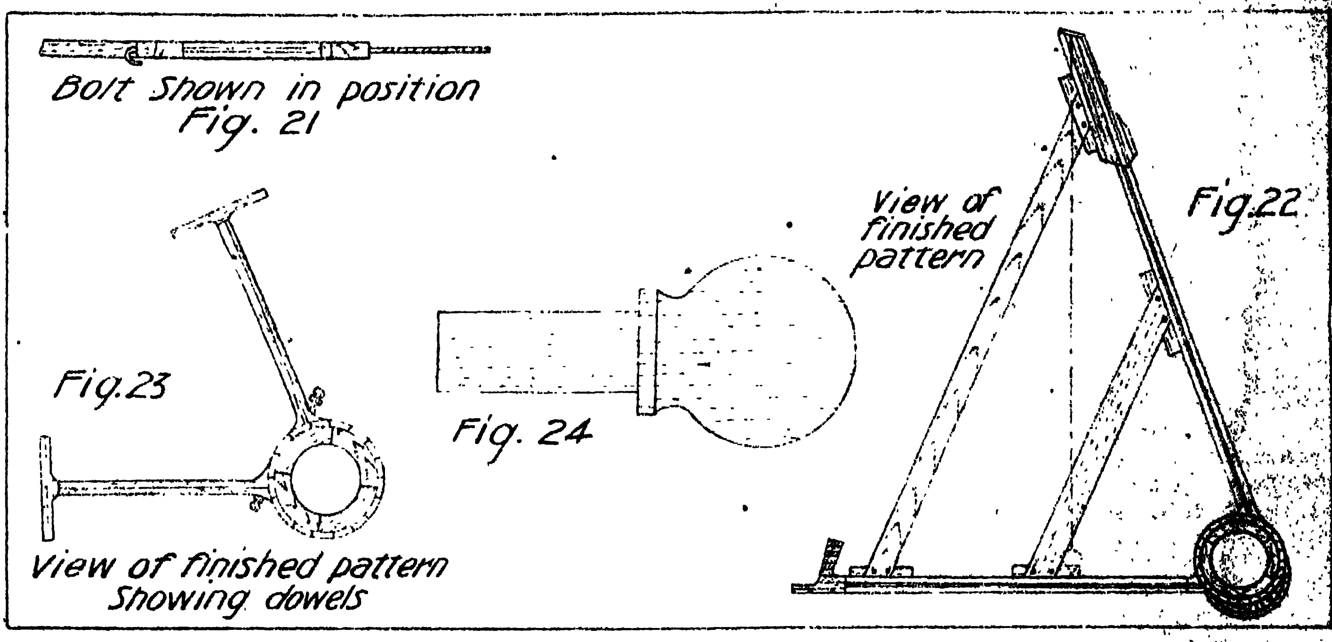


FIG. 21—HOOK BOLT SET IN POSITION FIG. 22—PROPELLER BRACKET PATTERN COMPLETED AND ASSEMBLED FIG. 23—COMPLETED PATTERN SHOWING THE USE OF DOWELS FIG. 24—DETAIL OF SUITABLE FORM OF DOWEL

[illegible]ces are straight, and can be [illegible]nd sand-papered to shape from a template. The fillet portions can be sawed roughly and finished off after the whole arm is built. Although in the sketch, Fig. 10, the arm *A* is shown the full length, the actual length is determined by the edge view. Thus in Fig. 12, it will be seen that the bevel on the back of the palm requires the frame to be made short. It is long enough, however, to support the thicker pieces *C* which have to be screwed on the face and left open-jointed. A portion of the face *B*, shown in Fig. 12, has to be left loose with a long taper at *D*, the purpose of which will be explained when the molding is described. To complete the arms *B* the flange or palm has to be finished and dowelled on. If a view like Fig. 13, is drawn, showing the shape on both ends of the palm and cross lines 1 inch in position on the barrel, and the finishing has to be done after it is built. The jointing of the lumber depends greatly upon the size, and the shape of the fillet, and no hard and fast rule can be applied to all cases. It is wise, of course, to feather-edge such fillets, where they join the barrel with the end of the grain. It must be remembered the fillets are not glued on, but have to be left loose, that is with screws inserted which can be withdrawn, allowing the barrel to lift from the sand. Screws may be put in from the outside temporarily, but after the fillets are built, and before they are cut, it is more convenient to screw them from the inside of the barrel. This is easy, as the barrel is large enough in diameter to permit a boy or man on the inside to use a screw driver. Each fillet will be considered separately. When the longitudinal center line of the bar lumber will correspond with the line of the top face of the arm frame. This will assure the recess for the dowel being correct.

A rough outline of the elliptical shape formed by the junction of the fillet with the barrel should be drawn on the latter. This is not a difficult matter as width and length are given on the working drawing, and as it has already been said the shape between is largely a matter for the craftsman's judgment. The line for the face of the fillet should be squared from the floor to the top of the stave. In building the layers of lumber for the fillets glue should be used, as not many screws can be left in while shaping.

When the top of the filler is built the table is removed. Two pieces, exactly the same thickness as the arm should form the next layer, and

the space between them will correspond with the width of the arm dowel. The bottom then can be built in a manner similar to the top. Some short laths of very straight grained pine and about ¼-inch square are a great help in shaping the fillets. This is better than to rely entirely on sight and touch, as both hand and eye fail to detect slight flats and lumps, after the craftsman has been working at the job for some time. Wherever the lath is tried on the fillet it should bed along its entire length. Sometimes these large fillets are built in four or more sections for convenience in handling, both in the patternshop and in the foundry, as the fillet must be drawn into the barrel space in the mold. This advantage, however, is balanced by the extra trouble in jointing and screwing the sections together after each cast. Jointing also destroys the reliability of the fillet as a guide for the arms. When the barrel is long the fillet extends from end to end, and it might be wise in such a case to make the fillet so that the top above the dowel can be drawn into the barrel separately from the bottom. When a fillet is made the barrel should be turned around and the other fillet built in a similar way. In this case new saddle pieces have to be made, and probably a new table, as the angles will be different. The careful workman will put on all the necessary center lines for both fillets, and make the tables and saddle pieces, before he begins the construction of the fillets. A slight error in these fillets will produce a big error in the length of the arms. Two views of the barrel with a finished fillet are given in Figs. 18 and 19.

It would be impossible to bolt the arms to the barrel unless provision is made for the nuts inside the barrel. Blocks *A*, Fig. 20, should be built and screwed inside to form a square face for the nuts. When the bolt holes have been bored the whole pattern is ready for assembly. The saddle pieces which were used for making the fillets are used again. The barrel should be set as it was when making a fillet. This means that in the length the arm will be level. A saddle piece should be made for the arm to rest in. The arrangement of these saddle pieces on the floor is shown in Fig. 17. The hook-bolts, two for an arm, are fixed as in Fig. 21, and when the arm is pushed into its position the nuts can be screwed on the inside of the barrel. In addition to the bolts it is as well to put in some temporary screws on the outside. The arm may be removed, and the barrel set to receive the other arm. It is advisable to bolt both arms in their positions resting on the floor. When the second arm has been fixed it is not necessary to remove it. The other arm is hoisted into position with a block and tackle or a crane, but as it has been in position it is not difficult to replace. The completed pattern is shown in Fig. 22. It is probable that the top arm will droop a little, unsupported. Stays are fitted between the arms to prevent this. It would be awkward to make and fit a half-lapped frame between the arms. The stays which are shown in the sketch should be dowelled and also screwed to blocks fixed on the arms. Before the holes are bored, however, the arms should be tested for position.

The distance between the tips of the arms on the centers can be obtained from the floor, and the work tested with a steel tape. The best test, however, and the only one which probably will satisfy an inspector, is to drop a plumb line from the center of the top palm to the floor, or the top of the other arm as the case may be, the corner having previously been marked. If reasonable skill has been expended in making and marking off the various parts, there will be no inaccuracy.

If the work is large it is much better to disassemble it and convey it to the foundry in parts, where it can be put together easily and quickly. The screws which must be drawn by the molder to get the fillet and the arms withdrawn from the mold, have to be painted round, so that none will be unnoticed and left in. Molders do not always remember to try if they can get every piece free, before bedding a pattern in the sand, although they should do so, and as with other steel castings, if square corners are wanted anywhere because of the plating, the fact should be written distinctly on the pattern.

For small brackets of this type, or even of the type described in the previous article, the arms may be constructed and fixed to the boss in another way. Where the arms are only 3 or 4 feet long it would be manifestly absurd to so build them. They may be bolted to the barrel, and it might not be possible to dovetail them. The usual practice and probably the best is to make a solid arm of two or three thicknesses of timber and screw extra thicknesses at the ends for fillets. When this is done the whole can be shaped at one operation, and fitted to the barrel. Screws will hold it quite rigid, but it will be a great convenience for the molder if dowel pins are put through the fillet into the barrel. These dowels should be 1½ inches or 2 inches in diameter, and with a good handle so that they can be withdrawn easily. A suitable form of dowel is shown in Fig. 24, and such a pattern shown finished in Fig. 23. It is often possible with these smaller brackets to screw the palms to the ends of the arms, either leaving the molder to arrange for the fillet, or making the fillet separately against the arm and palm so that it can be drawn in. If the foundry is near at hand and the patternmaker can be in attendance, or can be consulted by the molder, some details can be left, although it is wiser, within practical limits, to leave as little to the foundry as possible. After all, the patternmaker is working to a drawing, and it is not quite fair to the molder to expect him to know what is wanted, when he has not the opportunity to study the drawing.

There is no difficulty with the shaft core for the bracket, a plain board being all that is necessary.

Types of Foundry Buildings Described

The Austin Co., industrial engineers and builders, has just issued a new booklet known as catalog No. G. It contains cross-sections of the company's ten standard types of buildings and gives a description of Austin service to foundry and steel plant owners.

The object of this booklet is to condense the description of the Austin company's complete building service to a booklet that can be read in four or five minutes and that will fit the pocket conveniently.

New Core Binders

A new form of dry core binder has been developed by Corebind, Ltd., 5 Castle street, Finsbury, London, E. C. 2, England, and arrangements are being considered for marketing this product in the United States. Since the powder is furnished in dry form, it can easily be mixed with the sand in correct proportions even if the sand is already moist. The proportions of binder necessary vary from 1 to 20 to 1 to 40 according to the nature of the sand used.

A recently patented mixture for making molds for casting light metal articles is made of plaster of paris, 40 parts; asbestos fibre, 30 parts and brick dust, 30 parts.

Bethlehem's Ingot Mold Foundry

Direct Metal From Blast Furnaces as Well as Cupola Metal is Used—Arrangement For Storing and Charging Coke is Unique—Molds Are Poured From a Long Platform

By E. C. KREUTZBERG

PRIOR to the tremendous expansion in the steel production facilities of the Bethlehem Steel Co. during the past few years, all of the ingot-mold requirements of the company were taken care of by the iron foundry at the Lehigh plant. This foundry had sufficient capacity to produce 4000 to 4500 tons of ingot molds per month. After the Bethlehem Steel Co. took over the properties of the Maryland Steel Co., the Pennsylvania Steel Co. and the American Iron & Steel Mfg. Co., the capacity of the foundry at the Lehigh plant became wholly insufficient, and it became necessary to purchase a large portion of the ingot molds required for the operation of the various works.

In order to meet the needs resulting from this expansion, the erection of a new ingot-mold foundry was undertaken at Bethlehem. This plant, which only recently was completed, is an unusual establishment. Its capacity is 10,000 tons of ingot molds, stools and bottom plates per month. This output not only is large enough to supply the full requirements of the Bethlehem Steel Co. plants at Bethlehem, Sparrows Point, Lebanon and Steelton, but 30 to 35 per cent of the total capacity will be available to other eastern steelmakers. The new ingot mold foundry contains about 85,400 square feet of floor space, has a maximum length of 550 feet and a maximum width of 272 feet. Of this area, a 75 x 275-foot space is given over to the raw material yard which, unlike the stock department in most foundries, is completely covered by a roof. Of an unusually substantial character, the foundry building has a steel frame, brick walls, a poured gypsum roof and other details which make it thoroughly fireproof.

Mixer Metal Used

Due to the general plant layout at Bethlehem, the ingot mold foundry is arranged for handling both hot metal and pig iron. Hot metal is obtained from blast furnaces which supply all other departments of the plant; hence a supply of hot metal cannot at all times be obtained at the moment it is required. For this reason arangements were made for melting pig iron when hot metal cannot be obtained. Two cupolas, each with a capacity of 40,000 pounds per hour, and one 450-ton mixer comprise the equipment for providing metal at this foundry. Of the raw material for the cupolas, 90 per cent is bessemer pig iron made by the Bethlehem Steel Co. in its own blast furnaces. The remaining 10 per cent comprises scrap originating in the various departments of the company. The mixer, shown in an accompanying illustration, is of standard construction. It is equipped for burning oil or by-product coke oven gas, and hot metal may be maintained in it at a satisfactory temperature for any desired length of time.

The arrangement for handling the charges for the cupolas and for facilitating their operation generally is of considerable interest. For serving the cupolas, there are two platforms, one at the level of the spout and the other at the charging level. Pig iron and scrap are loaded into flat boxes, which are brought to the charging platform

FIG. 1—MOLDING FLOOR AND PIT SHOWING EQUIPMENT FOR PRODUCING INGOT MOLDS AT THE NEW FOUNDRY OF THE BETHLEHEM STEEL CO.

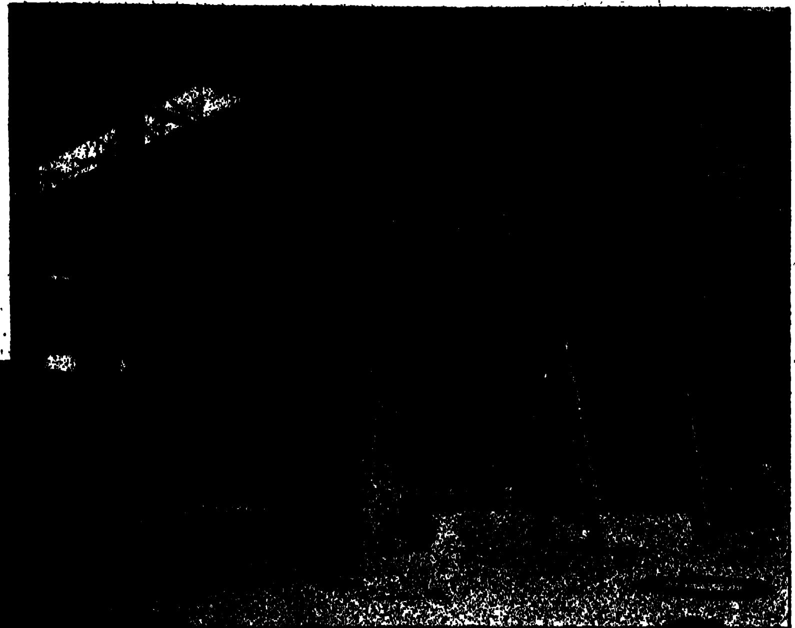


Fig. 2—Coke is Elevated to Bins Above the Charging Floor From Which Measuring Buckets Are Filled for Charging the Cupola, in Order to Save Labor in Handling.

Fig. 3—The Cupolas are Elevated so That the Bottoms May be Dropped Directly Into Cars Instead of on the Floor, Thus Saving Expensive Handling.

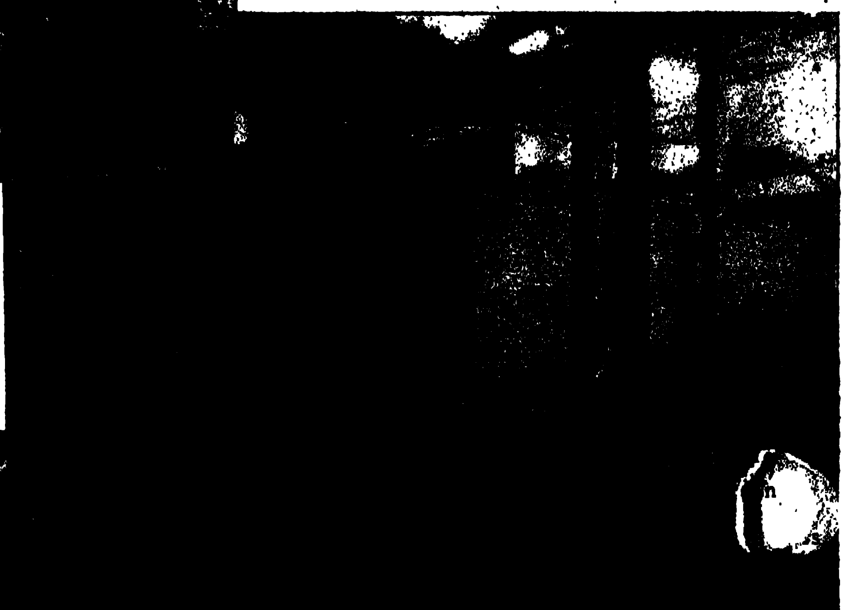


Fig. 4—The Foundry is Equipped With a 450-Ton Mixer Which is Charged With Molten Metal From the Blast Furnaces.

Fig. 5—The Molds Are Dried in Double-Ended Ovens From Which They Emerge Onto the Pouring Floor, Where They Are Placed Alongside the Pouring Platform.

by means of two 25-ton cranes which span the raw material yard. On the charging floor they are placed on buggies which are pushed in front of the charging doors where the pig iron and scrap are charged by hand to insure proper distribution of fuel and metal. All iron is charged by weight; fuel, however, is charged by volume.

How Coke is Handled

The iron is charged through doors at the front of the cupolas and the fuel through doors at the rear. Fuel is delivered to the foundry in cars which are spotted over track hoppers, and from the bottom of the hoppers the coke is conveyed by a skip hoist to bins above the charging floor. These bins are three in number and each has a capacity of [illegible] tons. From the bins the fuel passes into fixed-volume buckets, the flow being controlled by means of gates at the bottoms of the bins. In order to facilitate the removal of refuse from the cupolas, the latter were built at an elevation so as to afford ample clearance for cars which are spotted beneath them at the conclusion of each heat. Into these cars, which operate on rails, the bottom is dropped and the cars then are pushed to a dump where their contents are discharged. This system greatly decreases the amount of work necessary around the cupolas and accordingly cuts down the cost of operation. In order to have a clear space beneath the cupolas, the bottom doors are kept in place by pneumatic plungers, which are released at the time of dropping.

On the molding floor, specially designed 3-part flasks are used. The flasks are cast iron. Unlike the practice at many plants where the spindle is molded separately and set on the bottom plate, the Bethlehem Steel Co. molds the [illegible]m and spindle as a unit. In th[illegible]ion, the spindle is set in p[illegible] keyed to the cast-iron plate, after which the sand bottom is rammed. Next, the pattern is set in place over the spindle, being maintained rigidly in position by the use of an arbor which fits inside the top of the pattern and centers it about the spindle. The flask then is lowered onto the bottom, after which sand is filled in between the spindle and the pattern, and between the pattern and the flask, both being rammed together. The flask is then lifted and the pattern drawn. The ramming of the molds is done in pits, and the molding of the bottom and spindle in one piece results in a smooth casting since this method prevents the formaton of fins which result when the spindle is not integral with the bottom.

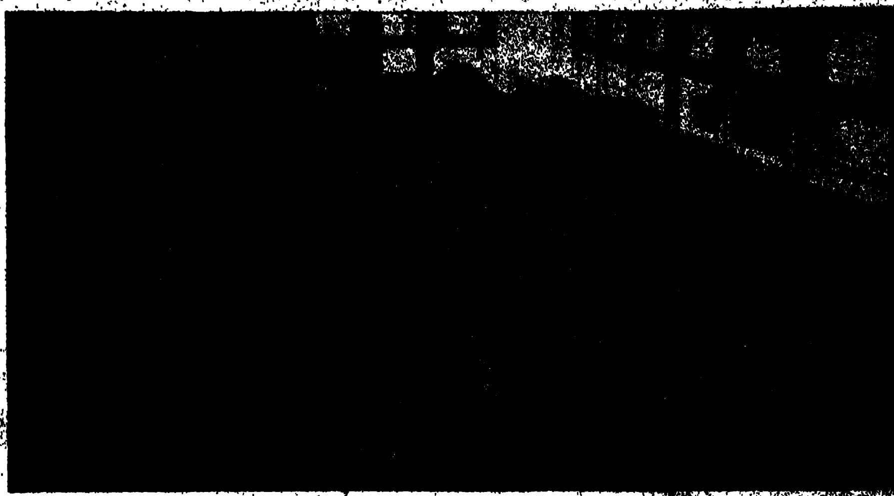


FIG. 5—THE STOCKYARD IS ENTIRELY PROTECTED FROM WEATHER AND IS [illegible] BY CRANES WHICH LIFT THE CHARGE FROM THE CUPOLA PLATFORM

From the molding pit the molds are transferred by cranes to the drying ovens. There are eight of these ovens, each 12 x 25 feet. They are of the car type and are fired with by-product coke oven gas. The entrance to these ovens is on the molding side and the exit, from which the dried molds are discharged, is on the pouring side of the shop. On being withdrawn from the ovens, the molds are assembled alongside a raised concrete pouring platform 7 feet wide and 175 feet long. Each mold, when rammed, is provided with a sprue reaching from the top down to the bottom in order that the casting may be poured from the bottom. In order to pour without causing injury to the mold, through spattering of the metal, the sprue is surmounted by a large sand box.

The use of the concrete pouring platform supercedes the old method of pouring in pits. It has been found that the platform makes it possible to assemble, finish and pour the molds with greater facility and a greater degree of safety than is possible with the pit pouring method.

General Equipment

In addition to the cranes in the raw material storage yard, the casting and cleaning section of the foundry is provided with one 40-ton and three 25-ton cranes. The mixer department is provided with a 100-ton ladle crane and the molding shop with three 25-ton cranes. The foundry is provided with a sand mixing screen and with a pneumatic system for conveying molding sand to the various floors. A 30 ton jar-ramming machine has just been installed for ramming the molds.

The foundry is provided with a full equipment of flasks large enough to produce molds for ingots ranging all the way from 6 x 6 inches up to 22 x 80 inches. Ingots of the latter size weigh 34,000 pounds each. The foundry equipment includes a wet pan for mixing material for luting the cupolas and also for mixing foundry facing.

The foundry is provided with the necessary equipment for finishing cast-iron flasks, including a planer, a radial drill and other machinery. Scales are at hand for weighing the individual molds as well as for weighing carload shipments of molds and of raw materials.

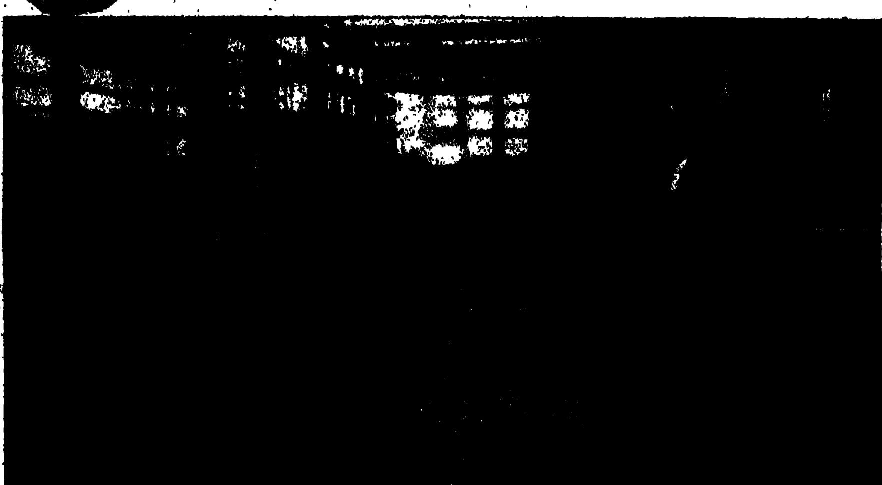


FIG. 6—AFTER COMING FROM THE DRYING OVENS, THE MOLDS ARE SET UP ALONGSIDE A 175-FOOT CONCRETE PLATFORM ON WHICH THE OPERATOR STANDS WHEN POURING

The Fourth, Fireworks and All'round Foundrymen

BY PAT DWYER

ON THE evening of July 4, which is also known and referred to in these United States and outlying island possessions as Independence Day, I went for a stroll in the park with the ultimate object of viewing the fireworks. Not verbal fireworks, but the real old simon pure article, rockets, pin wheels, nigger chasers and roman candles. The younger members of the family had brought home glowing accounts during the day of the progress of the work. Every step in the process of setting up the frames and scaffolds for the set pieces was carefully noted and reported upon. The evening meal was hurried through and we were on the way.

I was accompanied on this excursion by two charming young ladies who made up in volubility what they lacked in stature. I have been paying these young ladies' room and board bill for several years. I even buy clothes for them occasionally and if the shoes I bought for them were placed end to end they would reach from Fire Island light to the Golden Gate.

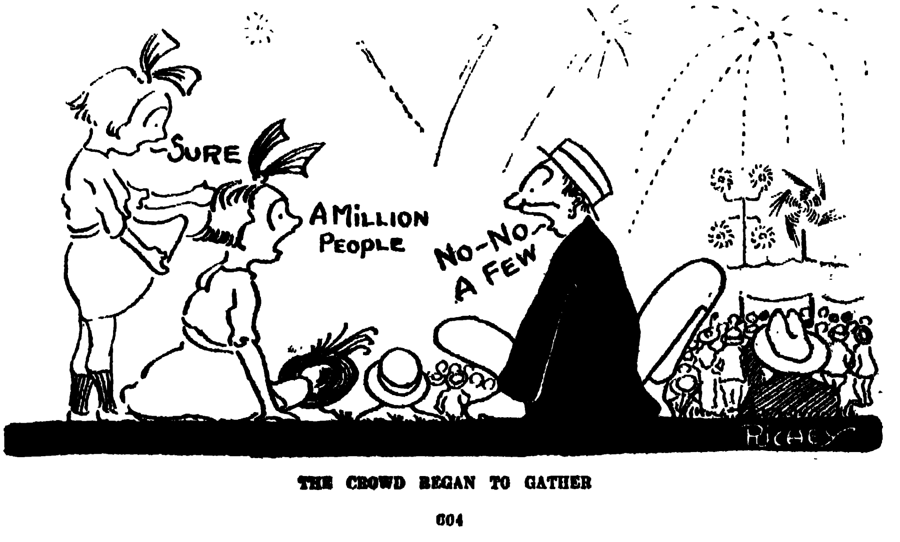
They arrived at our modest home within a few years of each other, without credentials of any kind. In fact they brought nothing, not even the clothes on their backs. My lady wife, who is a suspicious nature where strangers are concerned, waived all ceremony on their account and welcomed them quite effusively. I thought, at the time, that she was rather over enthusiastic considering that their appearance was a trifle unprepossessing—if you know what I mean. In the course of time I have come to share her enthusiasm and now I am as willing to uphold their claims to feminine pulchritude as any knight of the olden time who laid a spear in rest to prove the superior charms of his lady love. From occasional remarks which I have heard these ladies make, especially on paydays, I am led to believe that the feeling is reciprocal. All of which of course is very interesting to me, but what do you care? Nothing.

We went down to the park and after strolling around for a while we found a nice grassy spot and sat down. The crowd began to gather and one of the young ladies ventured the opinion that there were about a million people present. I was doubtful. I told her I was not in a position to give her the exact figures but I was quite positive it was not a million. "Well, then," said she, "half a million?" Judging from my expression that I did not agree with her she compromised by saying, "It is the biggest crowd *I* ever saw." I told her she was perfectly right, that was just about the exact size of the crowd.

There was music by the band, speeches by prominent citizens, and community singing. In a booth nearby a gentleman and his wife lately from some place in central Europe, dispensed ice cream and carbonated beverages. Needless to say the drinks were not sold under a good old sterling Anglo-Saxon title. The same process of evolution that is gradually wiping out the predominance of any one race or nationality in this country is also playing hob with our language. How else do you account for the fact that drinks which were known a few years ago and still are referred to in Boston as carbonated beverages are known in Buffalo, Erie, Cleveland and all points West as "pop"? The attention of the secret service department should be directed to this, the word "pop" has a teutonic sound.

Just before it became dark I saw a hat waving above the crowd. The old dip looked familiar and my opinion was verified a few minutes later when I made out Bill's long nose and bandy legs. We celebrated his arrival with another roun[illegible] the "ice cold" which Bill re[illegible]n-sisted upon paying for.

The mayor thanked the [illegible]one and all, for the attention to his few remarks, he hoped he would have the pleasure of addressing them again on the next Fourth of July (great cheering) then announced that the band would play "The Star Spangled Banner," to which he hoped all would lend their voices, after which the pyrotechnic display would take place. Immediately after proclaiming to all the world that this



THE CROWD BEGAN TO GATHER

was the land of the free and the home of the brave, the crowd wildly stampeded for the section of the field which had been roped off. I was quite satisfied to stay where we were but the young ladies insisted on getting down to the firing line. I had received strict orders before leaving home to be "careful of those children and keep out of the crowd" but I decided to take a chance and if anything happened I cou[illegible] blame it on Bill.

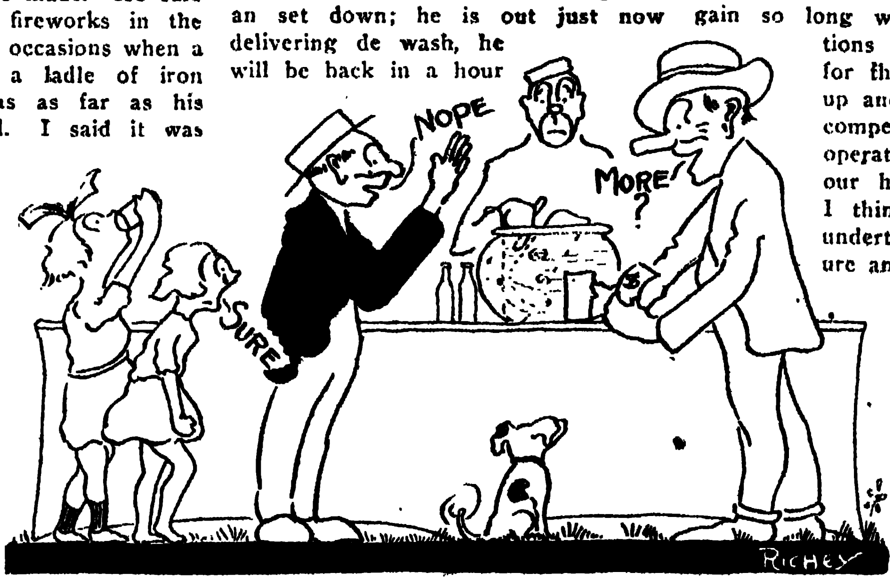
He went [illegible]ad and by the judicious use of [illegible] elbows and yelling of "gangway" every few steps we finally found ourselves up against the ropes. Soon the show was on in full swing and a chorus of "Ohs" and "Ahs" greeted every rocket.

I asked Bill if he had any idea how fire works were made. He said he had seen some fireworks in the foundry on different occasions when a mold blew up or a ladle of iron upset, but that was as far as his knowledge extended. I said it was simply pitiful how little the average man *did* know and he agreed with me. "Why, even in the foundry business," said he, "the condition of affairs is getting worse all the time. In the olden days, when we were young, a man had the opportunity to learn every branch of the trade. If he did not care to take advantage of it, that was his own fault. In these [illegible]r and degenerate days the bu[illegible] so divided and subdivided an[illegible]zed that a man only gets an[illegible]ity to learn one operation in the cycle that goes to make a casting. He is only a cog in the foundry gear wheel and if he drops out they can put a plug in his place. The all around foundryman will soon be classed with the dodo and the great auk. There soon won't be no such animal."

"Oh," I said, "I don't know about that, I heard the other day of at least one all around foundryman right here in town."

"I'd like to see him," said Bill, "where is he?"

"Well," said I, "I'll tell you all I know about him and then you can use your own judgment whether you want to go and see him or not. A friend of mine was out along Apahaukee avenue the other day selling foundry supplies. He saw a sign over a small building 'Brass Foundry,' and he attempted to enter. The place was locked but he was a determined kind of bird and besides his salesman's conscience (if there is such a thing) would give him no rest if he passed a foundry without attempting to make a sale. He knocked at the nearest house and a large colored lady came to the door with her sleeves rolled up and her arms wet from the wash tub. My friend bowed politely and asked the lady if she knew the foundry proprietor, or where he lived. She smiled on him expansively and said, 'Ah suah does, why ah owns him, he's ma husban an he lives right heah.' Our hero made known his business and asked if he might have the privilege of seeing him. 'Why, ce't'nly,' said she 'come right in an set down; he is out just now delivering de wash, he will be back in a hour or two and will be right pleased to meet yeh.' What do you think of that for an all around foundryman?"



THIS WAS AFTER JULY THE THIRST

"Sounds good," said Bill, "but I don't believe you. Your argument is irrevelant to the point at issue. When I spoke of an all around foundryman, I did not mean one who was all around the neighborhood. Neither had I reference to one who was all around like a beer barrel or a doughnut or a pint of half-and-half. What I meant was a man who had learned the foundry business thoroughly. The situation in the foundry industry is really becoming serious. So serious in fact that the United States government, through its depepartment of labor, is preparing to take action in the matter. In a preliminary report prepared by the department, it is pointed out that the supply of skilled foundrymen is entirely inadequate to cope with the present volume of business. It regrets that there is no apparent action by foundrymen to teach their employes and predicts a state of chaos when the present generation of foundrymen dies and the generation now growing up is placed in charge."

"You should change your name to Gloomy Gus," I said to him. "There is nothing to be alarmed about. The situation that is causing you and your friend, the department of labor, so much uneasiness is simply a case of times and methods changing. If we are young enough, we change with them and if we are not, we sit on the fence and grumble because things are not done the way they were when we were boys. All the grumbling in the world will not stop the march of events. So long as men have brains and use them either from pure love of achievement or for love of financial gain so long will industrial conditions keep changing. As for the industry withering up and dying for want of competent overseers and operatives after we take our hands off the wheel, I think you may let the undertaker take your measure any time. There were castings made on this old earth, thousands of years before the present generation of foundrymen howled their way into existence, and there is no reason why there should not be castings made after the last one of them has been permanently bedded in a pit six feet by two in the cemetery.

"The day of the all around molder or foundryman has gone by. The tendency in the foundry as in every other business is to divide every operation into its component parts, in order to employ more men and get a larger output than would otherwise be possible. In this way a minimum of individual skill is all that is required on the part of the operatives.

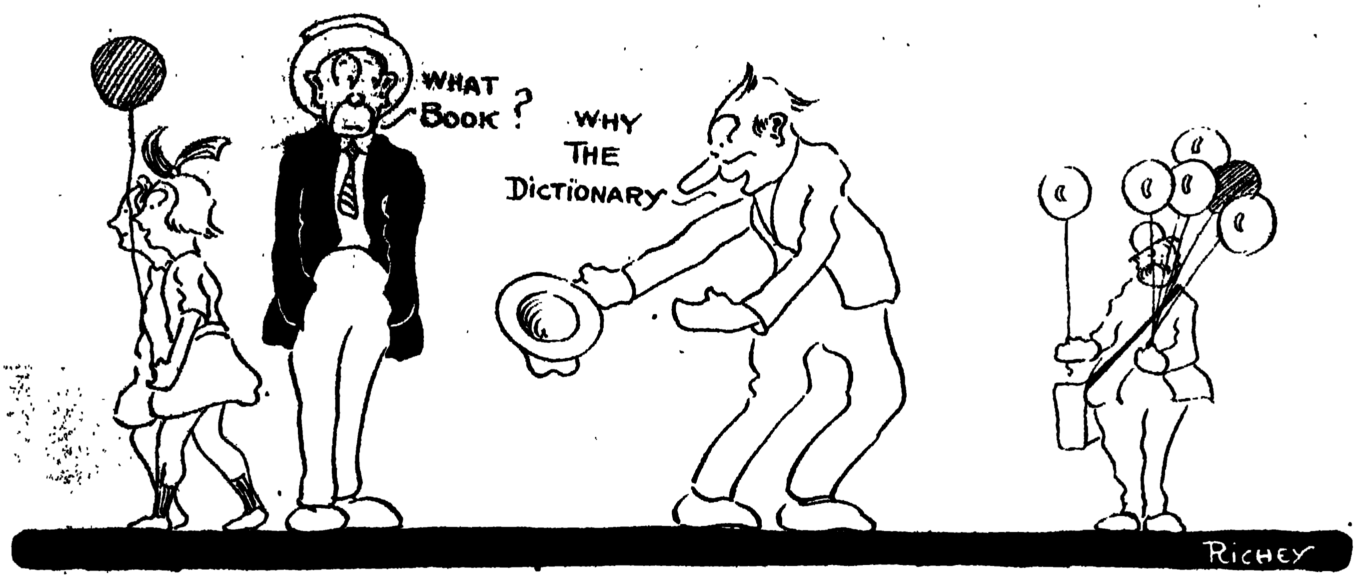
"The men in charge of foundries need to have a general knowledge of foundry operations but not necessarily an intimate knowledge of all the details. The boys who are destined to become foremen and superintendents will find ways and means to get the necessary information. It is not the man who knows the most, who is the most valuable. It is the man who knows how to use what he knows. Grant did not have any reputation as an A-1 all around soldier when Lin-

coln[illegible] for him, but he made a pretty good job of a certain little proposition that was put up to him. Neither Lincoln or Cleveland learned their trade in a modern president factory but you must admit that they were competent journeymen presidents. They had brains, ambition, courage and a sense of justice, and that is a combination that will land a man in the front rank either with or without training, when it is applied."

"Good night," said Bill, "if you are going to drag politics into the thing you can count me out. Besides that peroration of your's is all second-hand stuff; I saw every word of it in a book I have at home."

I indignantly dared him to prove it and asked him what was the title of the book in which he had seen it.

"The dictionary," said he, with a rather sarcastic grin.



How and Why in Brass Founding

By Charles Vickers

Proper Sand for Brass Castings

We operate a small brass foundry and have been advised by one of our customers that we could produce finer brass castings if we used a French sand. We have tried to secure some of this sand but so far without success. Can you advise us where to procure it? Also we would appreciate any advice concerning the best sand to use for fine brass castings.

French sand would be entirely unsuited to the class of castings being made in a small ordinary foundry. This sand is used in making statuary because it can be hammered against a pattern until so compact it will not break or tear when the section is removed. It is not suitable and is too expensive for ordinary molding. If an exceedingly fine grade of sand is desired, Windsor Locks as it is known would be suitable, and it can be obtained from any large foundry supply house. We are of the opinion, though, that satisfactory castings can be made by using ordinary brass molding sand make a specialty of fine grades of brass sand. Probably the sand now being used is of too coarse a grade and if this is found to be the case on comparing with the fine sand, all the old sand should be thrown aside or be stored and used in coremaking. Do not mix it with the new and finer sand, otherwise the castings will show little improvement.

High Pressure Alloys

We have lately experienced difficulty in getting castings that will not leak under air pressure. We have tried an alloy of copper 90 per cent; phosphor tin 10 per cent. The phosphor tin contained 5 per cent phosphorus, and thus added 0.5 per cent phosphorus to the alloy. Another alloy tried was copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent, but both alloys leak at 500 pounds air pressure. We are careful in melting the metals, using plenty of charcoal, and have tried both oil-fired and coke-fired furnaces with the same results. We make the cores with flour as a binder, making them weak, then spray with linseed oil to produce a skin.

It contained too much phosphorus, and the 88-10-2 is notoriously a difficult alloy to withstand pressure. If necessary to use one of the two alloys that have been tried, select the first one mentioned, but instead of using [illegible] phosphor tin, change the formula [illegible]er 90 per cent; common tin, 8 [illegible]; phosphor tin, 2 per cent, and [illegible]tle lead can be added, about 2 per cent, in place of 2 per cent copper or even 2 per cent of tin, the alloy will be improved. The following alloy, however, has been very successfully used for castings subjected to air pressures. Copper, 82 per cent; tin, 7.50 per cent; zinc, 5 per cent, and lead, 5.50 per cent. See that the castings are made with extra high heads to give plenty of pressure to the metal and pour with the metal hot.

Bushings of Copper Alloys

We have experienced considerable difficulty in making bushings of an alloy of copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent. We exercise all reasonable care in melting and molding, using charcoal on the metal, and working the sand as dry as possible, but the

holes. How can we remedy this condition? We also would like to learn where we can obtain reliable information concerning the state of the copper market.

There is a possibility that the porosity of the bushings is due to high sulphur in the fuel used in melting the metal. This will result in a furnace atmosphere strongly impregnated with sulphur dioxide gas, which will be absorbed by the copper if the charcoal covering burns away and exposes the metal to the furnace gases. This gas is also formed in the copper when sulphur and oxygen come into contact, and as the copper takes up both these elements readily, the gas is easily formed in the copper. This is a simple explanation of how the gas is formed; in reality the reactions are probably quite complicated. To prevent the formation of holes, the metal must be protected from the two elements that cause them. This can be done by covering the metal while melting with a tenacious flux, such as a mixture of powdered glass, borax and charcoal. Use about one part borax and charcoal to eight parts powdered glass.

Reliable information concerning the copper market can be obtained daily by subscribing to the *Daily Iron Trade and Metal Market Report,* Penton building, Cleveland, O. The subscription is $10 per year.

Cracking of Aluminum Crank Case Castings

We have experienced difficulty in casting a four-cylinder aluminum crankcase, about 18 by 9 inches in size. The inside of the case is cored out and although we have made the core as soft as possible consistent with sufficient strength for [illegible]ing, the casting cracked over th[illegible]ross almost the entire side, a[illegible]e got the core out as soon as [illegible]e after casting. Could you recommend a core mixture suitable for this casting, or would you suggest that a wedge-shaped arbor be placed in the core, and then be withdrawn as quickly as the cope could be removed from the poured mold?

It is seldom that a casting can be released from the sand after being poured in time to permit it to shrink without cracking, because it is necessary to wait until the metal is no longer liquid before the mold can be removed, and with most metals and alloys the contraction has then taken place, and the crack has formed if it is going to form. Aluminum bronze is an exception to this rule and that is why it can be used for die-castings. After solidification there is an appreciable interval before it contracts, and if the die is opened the casting is removed without difficulty, but if this is not done in time the casting will grip the mold firmly and be difficult to eject, and may possibly be broken.

Aluminum is tender as it congeals, but in spite of this complicated cored castings are made continually without cracking. The important thing is not to pour too hot. For a thin casting pour at 1300 degrees Fahr., by pyrometer, and use a core that is more easily burnt than an oil sand core. Such a core is a flour sand core, surface hardened by spraying with molasses water.

Difficulties With Fire-Hose Couplings

We have experienced some difficulty in making fire hose couplings. The work proceeds satisfactorily for a period of months, then we have trouble with excessive breakage, the castings are found to be perfectly sound, but crack under expansion. Our formula consists of copper, 89 per cent; zinc, 5 per cent; lead, 4.5 per cent, and tin, 1.5 per cent. We use no scrap metals outside of our own turnings and gates. We would appreciate advice in regard to this matter.

The difficulty being intermittent would indicate that some impurity occasionally gets into the metal and produces brittleness. If the alloy were a yellow brass, antimony would cause this difficulty when present in fractions of 1 per cent. With the alloy used, however, it is difficult to see how antimony can produce this breakage unless it is present in proportions higher than 1 per cent. The only certain way for discovering what causes the trouble is to have analyses made. Have a normal casting analyzed, then when the castings begin to fail by breakage, have the broken castings analyzed and compare the analysis with that of the normal casting. If antimony is found in the broken casting and not in the other, it will be evident what has caused the difficulty. Whatever it is the analysis will detect it and is the cheapest way of running down the difficulty.

Benedict Nickel or Benedict Metal?

We have an inquiry for an alloy known as "Benedict" metal and we would like to obtain the formula for the same. We have the formula for "Benedict" nickel, but this is not the mixture required. We assume the mixture is similar to the admiralty metal, copper, 70 per cent; tin, 1 per cent; zinc, 29 per cent.

"Benedict" nickel is an alloy of copper and nickel the proportions of which may vary within considerable limits, but usually it is composed of copper, 80 per cent, nickel 20 per cent. It is a rolling mixture and is used for tubing connected with plumbing fixtures, because it is white and maintains a creditable appearance after the nickel plating has worn off. "Benedict" metal is simply another name for "Benedict" nickel, and applies to the same mixture. However, it is possible that locally the name might be applied to any composition; therefore, if it is reasonably certain that a yellow brass is desired, the mixture mentioned could be used. Instead of regular admiralty metal it would be advisable to use some mixture that casts well. If the castings are to be machined, the following mixture would give satisfaction: Copper, 70 per cent; zinc, 25 per cent; tin, 2 per cent, and lead, 3 per cent. It would be advisable to get a sample of this particular "Benedict" metal, and if it has a white color, it is a copper-nickel alloy; if yellow, a copper-zinc alloy, when the above mixture should be used, and if it is gold color, it is a red brass, and any ordinary mixture of red metal such as copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent; lead, 5 per cent, would prove satisfactory.

Properties of Nickel-Copper Alloys

Kindly advise us regarding copper-nickel alloys such as copper 98 per cent, nickel, 2 per cent. We are confused in regard to the proper pouring temperature for these alloys.

According to Hiorns there are no chemical compounds of copper and nickel, neither is there any eutectic mixture, as the two metals form solid solutions or mixed crystals in all proportions. All the alloys with excess of nickel are magnetic, and those with excess of copper are nonmagnetic. Soft drawn alloys of copper 98 per cent, and nickel 2 per cent, have a tensile strength of 32,200 pounds per square inch, and when hard drawn, 53,392 pounds tensile strength. With 5 per cent nickel the tensile strength of soft drawn material is the same as the 2 per cent nickel alloy, and at 25 per cent nickel, the tensile strength is around 60,000 pounds per square inch.

In casting an alloy of copper 98 per cent and nickel 2 per cent, treat it in every respect the same as pure copper as the content of nickel is too small to have any effect from a foundry standpoint. The copper-nickel alloy will require deoxidizing exactly the same as in the case of pure copper, otherwise the castings in sand molds will be spongy. Either silico-calcium copper or magnesium-phosphor copper should be used in deoxidizing copper for shell bands, otherwise its ductility will be low.

Where Converter Castings Are Made

Cupolas Used for Melting the Metal in Converter Steel Foundries Show Remarkable Performance When Compared With the Practice Current in Most Gray Iron Shops

WHEN Henry Bessemer conceived the idea and later put into actual practice the principle of blowing a current of air through a quantity of molten iron thus converting it into steel, it is doubtful if he realized what a tremendous impetus the invention was to give to world trade. The development and importance of the steel industry may be likened to a certain extent to the career of the distinguished inventor.

There are many foundries in this country which make steel castings by the bessemer process exclusively, and of these the Burnside Steel Foundry Co., Chicago, is fairly representative. This company specializes in railway and traction work, but also does a general jobbing business in small and medium sized castings. The plan, Fig. 4, shows the arrangement of the plant and the location of various units that enter into the manufacturing activities. The building covers 31,600 square feet which may be divided into four sections. Reading up and from left to right they are: The molding floor, 180 x 60 feet; sand blast and cleaning room 100 x 20 feet; and the main bay 280 x 40 feet, one end of which is devoted to molding and the other to cleaning the castings. The section of the building shown in the upper part of the plan 280 x 20 feet is occupied by the core ovens, core room, cupolas and converters, the power house, arc welder and annealing ovens. This wing of the building as well as that portion housing the sand blast and tumbling barrels on the opposite side are extensions to the main building. The buildings are of steel frame construction with the roof and ends covered with corrugated sheet steel. The outside wall between the columns is built of brick to a height of four feet. From this elevation to the roof is one continuous window sash extending the entire length of the building. Fig. 3 indicates the excellent lighting and ventilating facilities thus afforded. The columns are 20 feet apart on the center lines, and between each pair are twelve 6-pane sections of windows which are hung on pivots and can be adjusted from the floor. Fig. 3 also shows a section of the shop where the light work is made. A day's supply of cores for one of the jobs which is going through on a production basis is piled in the foreground. This part of the shop, as may be seen from the plan, Fig. 4, is equipped with 11 molding machines of various types and makes. There are six Buch hand jolt and squeeze, one jolt squeeze and pattern draw constructed by The Arcade Mfg. Co., Freeport, Ill., two Osborn jolt and squeeze, and two plain squeezers from the Federal Foundry Supply Co., Cleveland. In addition to these there are two heavy-duty jolt roll-over pattern draw machines in the main bay, built by the Cleveland-Osborn Mfg. Co., Cleveland.

Nearly all the work is light and is poured in green sand. Some of the molds made in the bay devoted to heavy work are poured green and some of them are skin dried. It depends more on the shape of the casting than on the weight, whether the mold is to be dried or not.

Fig. 2 illustrates the machine on which grousers are made for caterpillar tractors. It is Buch combination hand jolt rollover pattern draw which takes both cope and drag at one time. In the illustration the cope and drag are ready to be taken away from the machine and set on the floor. After they are lifted, the platforms on which they are resting will be swung in under, to receive the pattern boards. An ingenious roll-over clamping device is in use on this machine. W[illegible]he cope and drag [illegible]med and th[illegible] boards in place the bar *A*, Fig. 2, is laid across with the pads *CC* resting one on each bottom board. The clamp *B* is then swung upright, the gap in the clamp engaging the bar *A*. The ends of the bar instead of being round, are eccentric; therefore by a turn of the handle *D* the bar is locked. The end of the clamp bolt is threaded and therefore it may be adjusted to fit flasks of different heights. The pattern and flask repair shop is located in a closed balcony at one end of the light work bay. In

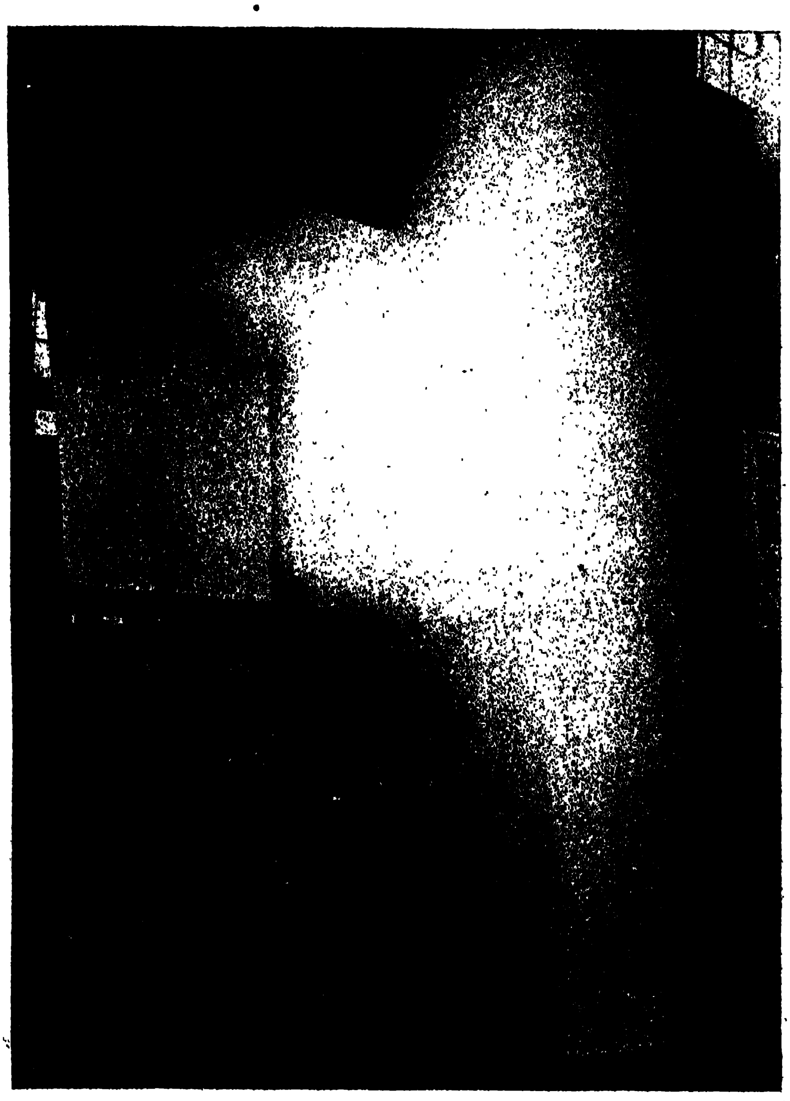


FIG. 1—NEARLY READY TO TIP AND POUR—THE BESSEMER CONVERTER IN ACTION

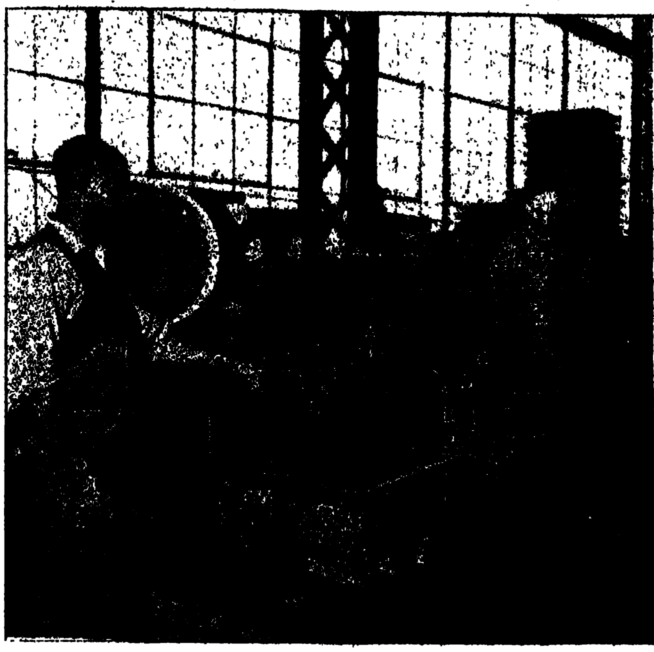
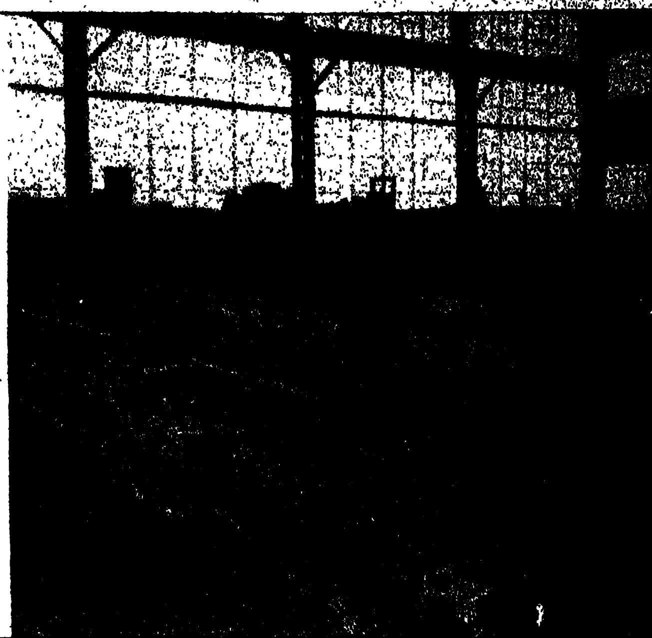



FIG. 2—ONE OF THE MACHINES ON WHICH THE GROUSER MOLDS ARE MADE—NOTE THE CLAMPING BAR A FOR HOLDING COPE AND DRAG WHILE TURNING. FIG. 3—A DAY'S SUPPLY OF CORES FOR TWO MACHINES

addition to the equipment of an ordinary pattern shop a miniature aluminum and brass foundry is provided in which to make or repair metal patterns. The quantity of metal used at any one time, of course, is not large and is melted in a small open gas-fired furnace.

One-third of the main bay is devoted to medium sized and heavy work, and is served by a 7½-ton Northern crane. Here also is located a 6-foot Simpson grinding pan for mixing the facing sand for the molders and two jolt roll-over draw machines made by the Cleveland-Osborn Mfg. Co., Cleveland. These are utilized when there is a large number of molds to make from one pattern. Most of the work made on this floor consists of miscellaneous parts with only one or two molds of a kind. Some of the castings in this bay are poured in green sand, but most of the molds are skin dried. Gas torches are used extensively for this purpose, although in some instances charcoal is found to be more convenient. Frequently both methods are used on the same mold; the gas torch on the drag and the charcoal fire under the cope.

The method of handling molten steel is illustrated in Fig. 5. The tap ladle is taken from the converter by the crane and set on the pouring stand shown. From this stand metal is distributed all over the shop in bull ladles. This applies only to the light work. The heavy castings, of course, are poured direct from the crane ladle. Unless otherwise specified the heavy castings are poured last from each heat. This is to secure a higher carbon content in the heavy than the light castings. In the converter the carbon is blown down to 0.18 per cent or 0.20 per cent or even lower for some classes of work. It is poured from the vessel into the ladle and a certain amount taken to pour the light castings. After a given amount has been taken out it becomes necessary to raise the carbon to a point suitable for the heavier castings. For this purpose a

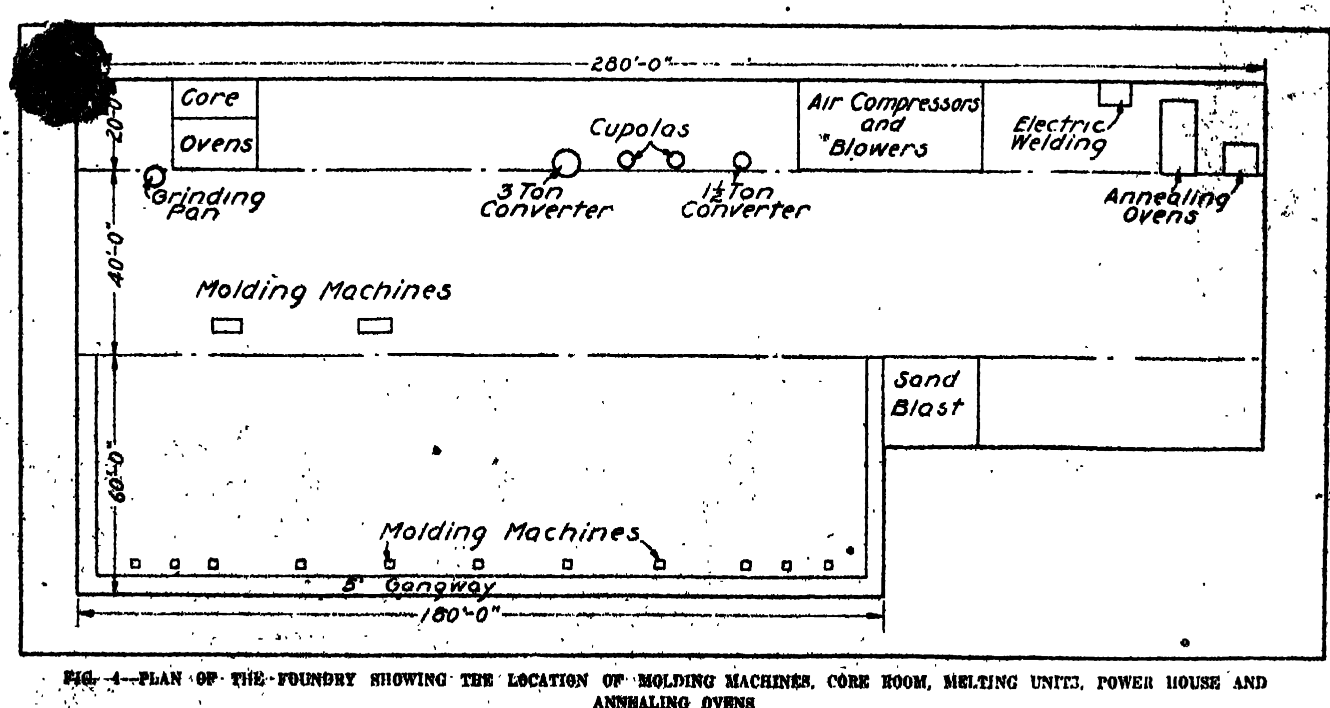


FIG. 4—PLAN OF THE FOUNDRY SHOWING THE LOCATION OF MOLDING MACHINES, CORE ROOM, MELTING UNITS, POWER HOUSE AND ANNEALING OVENS

FIG. 5—THE STEEL MAKING INSTALLATION—THE 28-INCH FURNACE SUPPLIES IRON FOR THE 1½-TON CONVERTER AND THE 42-INCH CUPOLA SERVES THE 3-TON VESSEL

ladle of iron is brought direct from the cupola and enough of iron transferred to the ladle of steel to bring the carbon to the desired point.

The converter at the left, in Fig. 5, blows a 2000-pound charge in about 15 minutes. When the color of the flame indicates that the proper carbon content has been reached, blowing is stopped and the steel poured into the ladle. Here the ferrosilicon and ferromanganese are added to bring it to the desired analysis. The converters are equipped with direct connected electrically operated tilting machinery. There are two cupolas and two converters in this shop, each pair constitutes a complete steel melting unit in itself. At the time the photograph was taken only the smaller one was in commission. The large converter is served by a 42-inch cupola and has a rated capacity of 6000 pounds. The smaller one is served by a 28-inch cupola and blows 2000 pounds each heat. At an average of three heats an hour that means that the 28-inch cupola has to supply nearly 8000 pounds of iron every hour for 6 or 7 hours a day, and not only for one day but for every day in the week. Iron foundrymen who have trouble with their furnaces could derive a great deal of profit by taking a leaf out of this steel foundryman's book. In fact a performance that would be regarded as remarkable in most iron foundries is here treated as a matter of course. Getting 20 tons of iron out of a 28-inch furnace in 6 or 7 hours is looked upon as an ordinary part of the days work.

In the illustration, Fig. 5, it will be noted that the windbox is considerably higher than is usual in furnaces of this size. The slag hole is 15 inches above the sand bed, which means that the furnace holds approximately 1800 pounds of iron before each tap, and therefore two taps will form a charge for the converter. The size of the furnace and the speed of the melting in an installation of this kind depends altogether on the ability of the converter to take care of the metal. The furnace charge consists of 60 per cent steel scrap in the form of shop scrap, draw-bar knuckles and coil springs. To this is added 40 per cent low phosphor pig iron. The

FIG. 6—OWING TO ITS EXTREME FLUIDITY ALL THE METAL IS POURED OVER THE LIP OF THE LADLE

charges are comparatively light, 500 pounds constituting a standard heat. On account of the high percentage of steel in the charge and of the high temperature required, the ratio of coke to iron averages about 5 or 6 to 1. A shovelful of limestone is thrown on each charge for flux. A blast pressure of 10 ounces is maintained throughout the heat and is supplied by a positive pressure blower. The ladles of iron are taken from the furnace to the converter by the crane. After the metal is blown the cranes again take it away. The analysis of the steel for most of the work is 0.18 per cent carbon, 0.30 per cent silicon, 0.08 per cent sulphur, 0.05 per cent phosphorus and 0.65 per cent manganese. The carbon is sometimes raised to as high as 0.80 per cent for large work and for special castings.

The cupola charging floor is served by a hydroair elevator. Adjacent to the elevator there is a cylindrical tank 4 feet in length by 20 inches in diameter which is kept filled with water in summer and oil in winter. From this tank one pipe leads to the elevator cylinder and another to the air supply line. By opening [illegible] the oil or water, as the case may be, is forced into the cylinder causing the platform or cage to rise. By opening the release valve the air escapes, the platform descends by gravity and forces the oil or water back into the tank again.

[illegible] pig [illegible] scrap are [illegible] from the [illegible] frame [illegible] [illegible] one [illegible] on two 18-inch wheels. This style of barrow is a comfortable height for loading and unloading. It also is capable of transporting about twice the load possible with the type of barrow having one wheel. A spur track runs alongside the building and all the raw material, iron, coke, limestone, sand, etc., is unloaded and piled close to the building.

The powerhouse is partitioned off from the rest of the building. The equipment consists of two angle-compound air compressors manufactured by the Sullivan Machinery Co., Chicago. These have a rated capacity of 450 and 1100 cubic feet of air a minute, respectively. The blowers for the two converters and for the 28-inch cupola were built by the P. H. & F. M. Roots Co., Connersville, Ind. The blower for the 42-inch cupola is a General Electric centrifugal blowing unit. The cupolas operate on a 10 or 12-ounce blast, but the converters require from $2\frac{1}{2}$ to 4-pound pressure.

The facilities for cleaning the castings are quite ample. They include a sand blast room 10 x 12 feet, manufactured by the Pangborn Corp., Hagerstown, Md.; one combined tumbling barrel and sand blast made by the Whiting Foundry & Equipment Co., Harvey, Ill.; and two [illegible] barrels [illegible] the W. W. Sly Mfg. Co., Cleveland. There is also a Milwaukee power sprue cutter and a 600-ampere electric arc welder.

There are two annealing ovens built by the American Foundry Equipment [illegible], New York. [illegible] In the other the castings are piled directly on the floor of the oven. Both of the ovens are heated by gas. In the large oven the gas enters through three ports in one of the side walls immediately under the roof, and is deflected downward. In the small oven the combustion chamber is under the floor. In both cases the castings are gradually brought to a temperature of 1600 degrees Fahr. This temperature is maintained for two or three hours depending on the size and general characteristics of the castings undergoing treatment. It is then allowed to drop. When the temperature reaches 1000 degrees Fahr. the castings may be taken out, but they are generally left until they are cold enough to handle.

FIG. 7—THE CORE ROOM—A STAND AT EACH COREMAKER'S BENCH SERVES TO HOLD HIS PLATES

The core room occupies the space along one side extending from the large converter to the end of the building. Oil sand cores are used throughout. The sand for them is mixed by hand and then passed through a Combes gyratory riddle. Fig. 7 shows the core benches and stands for holding the green cores. When commencing work each man places six plates on his stand. He fills the top plate with cores and carries it to the oven and keeps repeating the operation until all the plates are used. He then gets a fresh supply of plates. The cores are dried in three gas-fired ovens. Two of the ovens are of the drawer type since nearly all the cores are small. There is, however, a large oven with a car in which to dry the large cores. This oven [illegible] at slightly higher [illegible] than the smaller ovens in order to heat the large cores through to the center more quickly.

THE FOUNDRY

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Contents

Systems Change With the Times

EVENTS have moved rapidly during the past decade. There is not such a sharp line of demarcation between the shop and the office as there once was. In one way the recent war has been a blessing. It has dragged out of their hiding places and off their pedestals many a hoary fetish and belief; it has turned the light of ridicule on many a selfish proposition and punched full of holes the armor of conceit in which some long established practices were wont to take refuge. The foundryman who keeps abreast of the times know and recognizes these facts and adapts himself to meet them. He cheerfully scraps tools and processes when they become obsolete and just as cheerfully he scraps systems of management which might have been perfect in his father's time but which he knows are not in harmony with existing conditions. The spirit of co-operation and the square deal are spreading.

Light on Nonferrous Metallurgy

DURING the war a prominent foundry in the Middle West was asked to make eight hundred aluminum crankcase castings for airplane engines. The patterns were fitted up carefully and eight hundred molds were poured, but only three hundred and eighty good castings resulted. Experiences like this are not uncommon in nonferrous shops, specially when dealing with alloys of aluminum. Stories are current to the effect that certain foundries hold their average losses to less than 10 per cent but they are mostly myths. As a matter of fact aluminum is a difficult metal to handle and while losses do not usually exceed 50 per cent, as in the instance cited, they are prone to be heavy even under the most satisfactory conditions.

The situation, however, is creating its own remedy. Scientific research in the metallurgy of aluminum alloys is being stimulated on a large scale. In addition to the splendidly equipped and ably manned laboratories maintained by producers of aluminum products, such as that of the Aluminum Castings Co. described in our June 15 issue, the government is taking up the problem through the bureau of mines. Some of the first fruits of this effort are made available in this issue in an article on "Unsoundness in Aluminum Castings," by Robert J. Anderson. Mr. Anderson believes that porosity is one of the chief difficulties that must be overcome in connection with the development of satisfactory aluminum foundry conditions. His experiments indicate that porosity is a function of the pouring temperature, the maximum temperature to which the charge was heated in the furnace, and the length of time required to melt the charge. Mr. Anderson's conclusions are tentative but they point the way to an interesting and profitable field of investigation, which, it is to be hoped, will be more thoroughly explored.

As Mr. Anderson says, porosity is no myth, and his statement is corroborated by the figures on aluminum foundry losses presented in our July 1 issue. One of the most encouraging features of the government's investigation of this problem lies in the fact that the results of its work are public. There has been too much mystery in the past regarding nonferrous metallurgy. An atmosphere of alchemy is not conducive to progress.

Trade Outlook in the Foundry Industry

THE tide of orders for castings continues to rise and the books of some gray-iron foundries are overflowing. Prices of both raw materials and castings are less sensitive to small fluctuations in demand than was the case a few months ago. This relative stabilization of the price situation, even though it be temporary, is a business factor of considerable importance. Generally speaking, the world's production of commodities is increasing as a result of the tendency to restore normal conditions, and after the first rush of post war demand is over a gradual price liquidation must follow.

Orders Going East

Automobile and tractor manufacturers in the Middle West have exhausted the capacity of the foundries in their immediate district, and as a result inquiries for large quantities of gray-iron cylinder and other motor car castings are finding their way east. This is one of the most notable developments in the casting market. One inquiry now pending in the east calls for numerous different kinds of castings, and the number of castings in each classification ranges from 15,000 to 20,000. Another inquiry almost as large is also current. It is not known whether any eastern casting shops are considering these inquiries seriously, since the booking of the orders would necessitate considerable floor space and the purchase of a large amount of additional equipment. Additional labor also would be required. It is stated, however, that if this business is placed in the east, it will remain there permanently, the buyers agreeing to place orders regularly in the future with eastern foundries. It is not unlikely, therefore, that a few eastern plants may be prevailed upon to provide the necessary equipment to handle this work. Although the gray-iron foundry business is exceedingly good in all sections of the country, it is probably showing more activity in the east than elsewhere and in addition to the automobile work just mentioned, numerous other orders are in sight. A great improvement in conditions is reported by producers in Newark and other northern New Jersey districts. The foundries in that territory have as much work as they can handle. While prices on castings in the Newark district have not changed materially in the past two weeks, they continue strong and there is no longer any disposition to cut quotations. In metropolitan New York where unsatisfactory conditions have been noted previously, considerable improvement has taken place. Foundries in this territory devoted to the production of ornamental iron work, which have been running very slack, now say that orders for castings are beginning to appear in greater volume. As a result these foundries also are less eager to cut prices, although some shading still is being done. In the Cleveland and other central western districts, the volume of inquiries for iron castings shows no abatement and similar conditions are noted in Mississippi valley territory. Prices are firm throughout the country.

Labor is Scarce

One of the principal problems occupying the attention of foundrymen in various sections of the country is the shortage of workers of all kinds, particularly unskilled labor. For five years there has been practically no immigration and since the first of the year emigration has been considerable. The effect of this situation is becoming more and more pronounced in the unskilled labor market as time goes on. Because of the shortage of unskilled labor and handymen suitable for operating machines, it is difficult to maintain operations, even where the foundries have plenty of work on their books. Of course, these conditions add to the instability of the labor situation. Wages, however, are fairly steady for the time being and in districts where union shops are operated it is not expected there will be any change in current rates until existing agreements expire. Along the eastern seaboard the number of men applying for work is very small and the usual floating supply of molders and common laborers is almost nonexistent.

Prices Of Raw Materials for Foundry Use

CORRECTED TO AUG. 21.

Iron	
No. 2 Foundry, Valley	$26.75
No. 2 Southern, Birmingham	27.50
No. 2 Foundry, Chicago	26.75
No. 2 Foundry, Philadelphia	28.50 to 29 50
Basic, Valley	25.75
Mal'eable, Chicago	27.25
Malleable, Buffalo	27.25

Coke	
Connellsville foundry coke	5.50 to 6.50
Wise county foundry coke	6.50 to 7.50

Scrap	
•Heavy melting steel, Val'ey	$21.00 to 21.50
Heavy melting steel, Pittsburgh	21.00 to 21.50
Heavy melting steel, Chicago	20.00 to 20 50
Stove plate, Chicago	25.00 to 25.50
No. 1 cast, Chicago	27.50 to 28.00
No. 1 cast, Philadelphia	25.00 to 26.00
No. 1 cast, Birmingham	24.00 to 25.00
Car wheels, iron, Pittsburgh	25.00 to 25.50
Car whee's, iron, Chicago	24 50 to 25.00
Railroad malleable, Chicago	23.50 to 24 00
Agricultural malleable, Chicago	21.50 to 22.50

Raw Material Markets

The rush for pig iron which has been in evidence during the past month, has subsided to some extent, although the demand for all grades suitable for casting purposes, continues heavy. Most producers are booked up for the remainder of the year. It is now believed in the Middle West that some shortage may be felt later in the year as inquiry is still active in the Chicago territory and many melters apparently have not covered. Prices are about $1 a ton higher in the south. Scrap quotations, however, are generally low owing to larger offerings from country sources. The coke market has experienced a radical change in the past two weeks and instead of being in the buyer's favor, it is now tending strongly toward prices in effect during the period of government control. The transition of the coke market from a condition of weakness to one of strength may be ascribed to the fact that fear of a shortage later in the year has prompted considerable buying for stock. Buying of nonferrous metals is on a comparatively small scale. The shortage of labor has curtailed the production of copper, zinc and lead. Prices of nonferrous metals are moving within relatively narrow limits. New York quotations are as follows: Casting copper, 22.50c; lead, 5.90c to 6c; tin, 56c; antimony, 8,75c; aluminum, No. 12 alloy, 28c.

Comings and Goings of Foundrymen

EUGENE F. BALL, who was re-elected president of the National Association of Pattern Manufacturers at its second annual convention, held at the Hotel Statler, Buffalo, Aug. 16-17, is general manager of the Newark Stamping & Foundry Co., Newark, O. Mr. Ball enters his third term as president, having held that office in the original organization, known as the Inter-State Association of Pattern Manufacturers, which became the National association in 1918. It was at the suggestion of Mr. Ball and E. O. Melvin of Columbus, O., that an organization of this character was started and proof of its popularity is found in the fact that in the last year its membership has grown from 28 to over 200.

L. G. Williams, East View Farm, R. 6, Box 50, Hopkinsville, Ky., is organizing a company to build a plant in Oklahoma for the manufacture of farm and mining machinery. A small foundry equipped with modern devices, an up-to-date brass foundry, machine, blacksmith's and forge shops, equipped with labor-saving appliances and automatic machinery, and a pattern shop with modern wood-working equipment all are contemplated.

W. L. Shaughnessy and J. P. Carney of the William L. Shaughnessy Co., Gardner, Mass., manufacturer of casket hardware, recently purchased the foundry, operated by Lord, Stone & Co., Otter River, Mass. They will form a new company, incorporated at $50,000, to be known as the Otter River Foundry Co. They will continue the manufacture of stoves, which the foundry has been producing for a number of years.

F. J. McGrail, who has had charge of the foundries of the Honolulu Iron Works Co., Honolulu, Hawaii, for some time, formerly was with the Henry R. Worthington Pump Co., Harrison, N. J., and for eight years was foundry superintendent of the Struthers-Wells Co., Warren, Pa., resigning that position to locate in Honolulu last May.

Edward Shearson of Shearson, Hammill & Co., New York, resigned recently as director of the American Steel Foundries.

I. F. Blank, who recently resigned from the bureau of mines, where he was doing experimental work in connection with the extraction of helium from natural gas for use in balloons, now is identified with the Wilson Foundry & Machine Co., Pontiac, Mich., doing foundry efficiency work and assisting the foundry engineer in foundry methods. Mr. Blank enlisted in the chemical warfare service division in September, 1917, and was discharged as a lieutenant in January, 1918, when he accepted the position in the bureau of mines. Prior to his enlistment, he was connected with the methods department of the Western Electric Co., Hawthorne station, Chicago, having charge of the methods and efficiency work in its foundries.

George N. Peek, formerly vice chairman of the war industries board and

EUGENE F. BALL

former vice president of Deere & Co., Moline, Ill., has been elected president and general manager of the Moline Plow Co., to fill the vacancy caused by the retirement of Frank G. Allen, who was its head for many years.

C. Bateman Swasey was recently elected treasurer of the Belcher Malleable Iron Co., Easton, Mass. Formerly Mr Swasey was superintendent of the Gorham Mfg. Co.'s Allen avenue plant, Providence, R. I.

Lieut. Clifford L. Snyder, who recently was discharged from the army, has become affiliated with the technical staff of the Detroit Testing Laboratory as sales engineer. Lieutenant Snyder received his commission at Fort Sheridan, Illinois, and later was transferred to the nitrate division in charge of construction work at plant No. 1, Sheffield, Ala.

H. C. Southgate, formerly local treasurer of the Chicago works of the National Malleable Castings Co., Cleveland, who has been absent from the organization for the past seven years, has returned to the Chicago works as assistant local treasurer.

Andrew K. Barr has been made foundry superintendent at the Wakefield, Mass., branch of the Gibby Foundry Co., Boston. He formerly was foreman patternmaker with Davis & Furber Machine Co., North Andover, Mass., since January, 1913.

M. W. McClane was elected president of the Aetna Foundry & Machine Co., Warren, O., at a recent annual meeting of stockholders. Mr. McClane, W. M. McKee, G. P. Gillmer, V. E. Rehr were elected directors. Mr. Rehr was also elected vice president; G. P. Gillmer, treasurer, and M. C. Boyd, secretary.

Judge Will Cummings was elected president of the Southern Foundry & Machine Co., Chattanooga, Tenn., at its recent organization. E. D. Herron was elected vice president and general manager.

Albert A. Smith of Albert Smith & Co., Glasgow, Scotland, foundry engineers and machinery merchants, has arrived in the United States to visit American manufacturers of labor-saving machinery suitable for use in foundries and patternshops, for which, he says, there is a large market in Great Britain.

J. H. Hogue, formerly affiliated with the Great Western Mfg. Co., Leavenworth, Kans., assumed his duties as foundry superintendent for the French Oil Mill Machinery Co., Piqua, O., on Sept. 1.

E. W. Wallbank has been made superintendent for the Parkersburg Rig & Reel Co., Parkersburg, W. Va. He formerly was tool designer with the Savage Arms Corp., Sharon, Pa., and prior to that time was foreman machinist with the New York Yacht & Engine Co., New York City; foreman patternmaker with the Producers' Supply Co., Franklin, Pa.; and tool designer with the General Electric Co., Erie, Pa. He also has contributed various articles on patternmaking and molding methods to THE FOUNDRY.

Carl F. Dietz was appointed vice president and general sales manager of the Norton Co., Worcester, Mass., in the reorganization which followed the com-

bining of the Norton Co. and the Norton Grinding Co., noted in the Aug. 1 issue. W. LaCoste Neilson was appointed vice president and foreign manager; Herbert Duckworth and Howard W. Dunbar, sales managers of the grinding wheel and grinding machine divisions, respectively; John C. Spence and Charles H. Norton, superintendent and chief engineer, respectively of the grinding machine division.

J. L. Dixon, formerly connected with the John A. Crowley Co., now is associated with the T. W. Price Engineering Co., Woolworth building, New York, as metallurgist and electric furnace engineer. Mr. Dixon has had a wide experience in the design, installation and operation of electric furnaces for foundries covering a period of over 11 years. The T. W. Price Engineering Co. will continue the construction and installation of electric furnaces.

James Savage, formerly of Brooklyn N. Y., now is foundry superintendent for the Atkinson Co., Rochester, N. Y., successor to Clum & Atkinson.

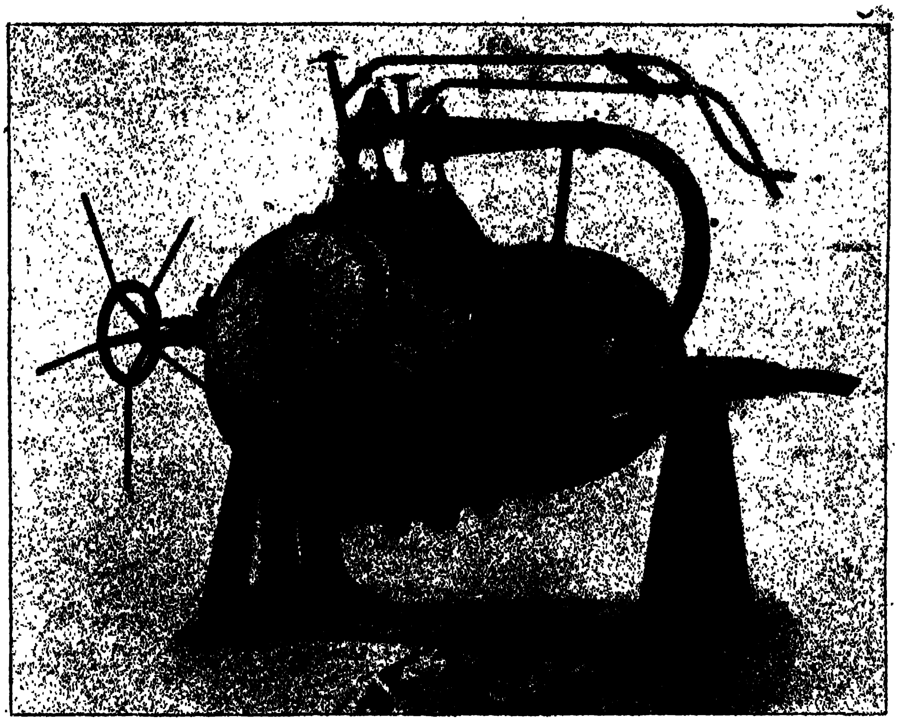
W. T. Howell, formerly with the Stewart-Warner Speedometer Corp., Beloit, Wis., has been made superintendent of the foundries operated by the Emerson-Brantingham Implement Co., Rockford, Ill.

A. Bigelow, formerly with the Metz Automobile Co., Waltham, Mass., has been made superintendent of the brass and aluminum foundry of the Rider-Bagg Co., Springfield, Mass.

The Philadelphia local committee of the American Foundrymen's association has issued an artistic multicolored poster announcing the annual convention and exhibition of the association to be held in Philadelphia Sept. 29-Oct. 3. The Liberty bell adorns the head of the poster. On one side of it is a locomotive and on the other side is a ship under construction, typifying two industries in which Philadelphia holds a prominent position.

New Oil-Fired Tilting Furnace Developed

A new type of oil-fired melting furnace has been developed by the Monometer Mfg. Co., Ltd., Birmingham, Eng. This furnace, which is shown in the accompanying illustration, was designed by Isaiah Hall, an English inventor and metallurgist, who is managing director of the company. The melting chamber is elliptical, and is mounted upon trunnions so that it may be rotated horizontally by gears actuated by a hand wheel. The burners are placed at the top as shown, and flexible hose connections to the feed lines permit freedom of movement in tilting. The internal measurement of the type shown is 2 x 3 x 6 feet, a size, which it is said, will melt from 1800 to 3000 pounds of metal to the charge. The cap bearings may be removed, the fuel and air line couplings disconnected and the entire furnace may be picked up by a crane and carried to any part of the foundry for pouring direct into the mold, if desired. This removable feature permits a spare melting chamber to be provided, to be used while another is being relined, thus avoiding interruption.



OIL-FIRED MELTING FURNACE

The proportion and pressure of both air and oil may be regulated independently to suit the conditions required. Temperatures in excess of 1800 degrees Cent. may be obtained, and it is said that the burners are so directed that a blanket flame is secured over the entire surface of the bath. The oil supply is delivered under gravity pressure, and an air pressure of from 2 to 5 pounds is required. Air pressure is controlled by hand valves at each burner. The flame may be cut off temporarily to allow inspection of the charge within. This inspection is further facilitated by the circular door at the front of the furnace, through which the products of combustion escape when the flame is on.

It is stated that this furnace may be used economically in the gray-iron plant as an accessory melting medium with the cupola, in steel foundries for melting alloys, and in nonferrous foundries for general melting purposes. The fuel cost per unit is a variable factor, depending upon the heat which it is necessary to develop with the different metals. It is stated that the lining is durable. The time required to melt a charge of pig iron is given from 45 minutes to an hour. An output of six tons per day of 10 hours is possible at this rate of melting.

This furnace is the latest product of the Monometer Mfg. Co., Ltd., which specializes in crucible and noncrucible melting furnaces, both of the tilting and stationary type, de-tinning, wire-tinning, cable-covering, and die casting machines. The company anticipates the establishment of an American manufacturing branch to manufacture its line of products.

Captain Teixeira, a member of the Brazilian military commission, who recently spent several months in this country investigating steel plant and electric furnaces particularly, has placed an order through Fenwick Freres & Co., New York, for a Greaves Etchells electric furnace, manufactured by the Electric Furnace Construction Co., Finance building, Philadelphia.

The Norton Co., Worcester, Mass., has established a store at 73 West Congress street, Detroit, to handle grinding wheels and abrasive products used extensively in automobile manufacture. The store and service department of the new branch will be managed by C. W. Jinnette, who has been Detroit representative of the company for a number of years.

New Wafer Compressor Valves

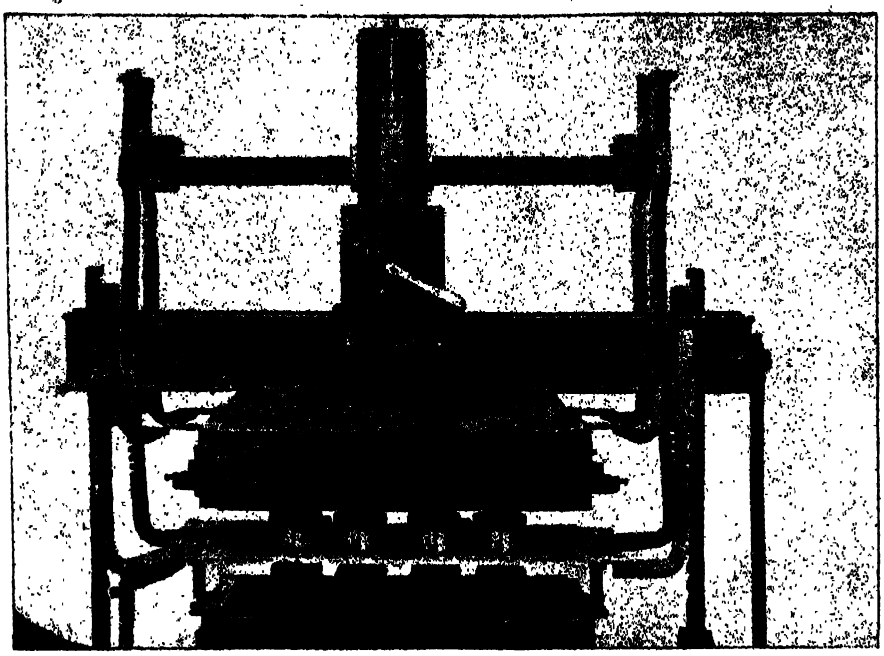
The Sullivan Machinery Co., Chicago, is embodying a wafer air compressor valve as an improvement on several of its single-stage steam and belt driven compressors. The small size, light weight and compactness of the valve and its spring and seat are shown in the illustration below.

The wafer valves seat in cages arranged radialy to the axis, and close to the two ends of the cylinder, the inlet valve being at the bottom and the discharge valve at the top. The valves are held to their seats by flat annular steel springs; they open against specially designed guard plates intended to give a wide port opening with a minimum of clearance volume. The valve, spring and guard are accessible by removal of a screw plug.

The short and simple construction of the springs permits the valves to be located quite close to the bore of the cylinder. The question of repair stock is simplified because the same valves, springs and guards are used for both inlet and discharge.

Compressors equipped with these valves are unloaded in the same manner as those having automatic poppet valves. There is an air pipe connection from the receiver which is controlled by a pilot valve at the side of the air cylinder. When the receiver pressure rises to the unloading limit the pilot valve admits air pressure through branch pipes to small plunger pistons located in the valve plugs. The other end of the piston carries a three-pronged extension which raises the inlet valve from its seat until the receiver pressure falls the required amount, thereupon the plunger piston falls, the valve seats, and the compressor resumes its operation. While the valve is raised and the unloader in action, no air is compressed, the piston of the compressor simply carrying the air at atmospheric pressure through the cylinder and open valves.

WAFER COMPRESSOR VALVE PARTS



MOLDING MACHINE OF PLUNGER TYPE EQUIPPED WITH COPE-HANDLING AND PATTERN-DRAWING DEVICE SHOWING MOLD OPENED AND PATTERN READY FOR REMOVAL

Cope Lifting and Pattern Drawing Attachment

An improved form of cope handling and pattern drawing attachment has been placed on the market by the Foundry Appliance Co., Newark, N. J. It is stated it may be attached with a few set screws and the aid of a monkey wrench to any air squeezer of the plunger type. Conceived originally for handling deep, heavy copes; the application of the device has been extended to all sizes of flasks, including molds of the flat-back type. The cope is lifted and the pattern drawn mechanically. It is claimed that by its use production has been increased from 33 1-3 to 100 per cent, this increase being due to the elimination of all unnecessary labor. Furthermore it is claimed that its employment not only dispenses with 50 per cent of the labor but removes the necessity for molding skill on the part of the machine operator.

The device consists of two parts. The upper portion which performs the functions of cope lifting and pattern drawing, is mounted on the cross rail of the molding machine. Two vertical arms, one on either side, are suspended from a horizontal bar. This bar is in turn suspended from a counterweighted cable which passes over a sheave. Each of the arms is provided with two sets of lugs which intercept respectively, the cope and pattern plate as the plunger of the machine is lowered after the mold has been rammed. The arms are mounted on scale point bearings. This feature, in conjunction with the suspension of the entire upper portion of the device from a single cable, insures the proper alignment of the cope and pattern, irrespective of the position in which the mold is rammed. The use of scale point bearings also insures compensation for any irregularity on the flask.

The distance between the vertical arms may be increased or decreased

to allow for any size of flask, and the elevations of the lugs may be adjusted at will. The vertical motion of the upper part of the device is governed by the position of the counterweight. This is set upon a slight incline and may be moved up and down by the molder as required.

The second of the two principal parts of the device is a movable table which is clamped to the molding machine table proper. It is mounted on rollers, making it possible to pull the drag forward in order to set cores after the mold has been opened.

Book Review

Abrasives and Abrasive Wheels, by Fred B. Jacobs; cloth, 340 pages, 5 x 8 inches; published by the Norman W. Henley Publishing Co., New York, and furnished by THE FOUNDRY for $3.

Abrasives and Abrasive Wheels contains valuable information for the ship or foundry superintendent and for the man who is engaged in the operation of grinding machinery of any kind.

The forepart of the book is devoted to natural and artificial abrasive materials such as emery, corundum, garnet, quartz, etc. Under the heading of artificial abrasives, the manufacture of carborundum and other well known manufactured abrasives is fully explained. The chapter on the manufacture of grinding wheels describes the lengthy process through which the material progresses until it is ready for shipment.

The testing of grinding wheels for efficiency is fully explained and illustrated by examples taken from actual working conditions. It is pointed out that by getting the right wheel in the right place, the manufacturer who is a large consumer can save thousands of dollars annually. In one chapter it is claimed that large wheels are more economical than small ones. The author has analyzed several popular sized wheels from a standard wheel list, determining the cubical contents and cost per cubic inch. It is shown that as the size increases the price decreases.

The subject of grinding wheel grits and grades, generally a confusing one to the average layman, is made plain. It is pointed out that grinding wheel manufacturers have never adopted a standard grade list and that such a procedure would save much confusion. With a view of hastening the adoption of a standard list, the author has included a table of standard grades of well known wheels, accurately compared. He explains how this list was prepared and comments upon its accuracy. A proposed standard grade scale is included in the chapter.

Other subjects treated include safeguarding grinding wheels, information for ordering grinding wheels, the design of dust collecting systems, etc. The latter part of the book is devoted to cylindrical, internal and surface grinding, cutter sharpening, etc. Several special grinding operations are fully described.

According to the researches of Leon Guillet and Victor Bernard of France, undertaken with a view of ascertaining if alloys having zinc as a base could be substituted for commercial copper base alloys such as brass and composition metal, an alloy containing zinc, 98 per cent, and aluminum, 2 per cent, appeared promising, but a better alloy is one containing zinc, 88 per cent; copper, 4 per cent, and aluminum, 8 per cent. These alloys were studied to ascertain their hardness, forging temperatures and resistance to shock.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

A small addition will be erected by the Sacks Foundry, Newark, N. J.

A plant is being erected by the Marion Foundry Corp., Marion, Ind.

C. Bulups & Sons Co., Norfolk, Va., has awarded a contract for the erection of a foundry.

Erection of a modern foundry is being planned by the Rathbone Mfg. Co., Grand Rapids, Mich.

The Bunner Gas Range Co., South Bend, Ind., has increased its capital from $75,000 to $100,000.

An addition is being erected at the plant of the St. Marys Foundry Co., St. Marys, O.

A new foundry building is being erected by the Pacific Brass & Steel Foundry, Portland, Oreg.

The plant of the Beaulieu Foundry, Nicolet, Que., recently was damaged by fire.

A. F. Wendling has the contract to erect a foundry addition for Russell & Co., Massillon, O.

J. A. Serigny, Nicolet, Que., plans to erect a modern foundry building.

The pattern shop of the Gardner General Foundry Co., Gardner, Mass., recently was damaged by fire.

Erection of a foundry is contemplated by the Willys-Morrow Co., Elmira, N. Y.

Plant additions, including a foundry, will be erected by the Robbins & Myers Co., Springfield, O.

Kaufman Bros., Ashland, O., plan the erection of a small foundry and office building, 45 x 70 feet.

A foundry and machine shop will be erected at Williamstown, N. J., by the Pusey & Jones Co.

Dick Bros., Inc., 20 Penn street, Reading, Pa., is reported contemplating the equipping of a foundry.

New plant additions which are being completed will make the melting capacity of the Saginaw Malleable Iron Co., Saginaw, Mich., 160 tons a day.

Due to increased business the Western Malleables Co., Beaver Dam, Wis., has found it necessary to reopen its South street foundry.

Burnett & Crampton, Rigaud, Que., are having plans prepared for the erection of a foundry to have a capacity of 250 tons of castings a month.

W. A. Molne, architect, is preparing plans for the erection of additions to the plant of the International Malleable Iron Co., Guelph, Ont.

Erection of an addition, 54 x 100 feet, is contemplated by the Riverside Foundry Co., Wrightsville, Pa.

Bids are being taken for the erection of two plant additions, 85 x 100 feet and 43 x 65 feet, for the Sun Ray Stove Co., Delaware, O.

Bids are being taken for the erection of a foundry, 100 x 220 feet, for the Parkersburg Rig & Reel Co., Parkersburg, W. Va.

The Baltimore Car & Foundry Co., Curtis Bay, Baltimore, is reported having purchased property adjoining its plant.

Plans are being drawn for the erection of a foundry addition, 90 x 90 feet, at the plant of the E. H. Bardes Range & Foundry Co., Cincinnati.

The capacity of the foundry of the Wausau Foundry & Machine Co., Wausau, Wis., will be increased.

An increase in capital stock from $60,000 to $79,000 has been authorized by the stockholders of the Aetna Steel Castings Co., Cleveland.

The Sommer Adams Co., 2934 East Fifty-fifth street, Cleveland, will make alterations to its foundry and machine shop.

The Des Moines Foundry & Machine Co., Des Moines, Iowa, recently organized, will build a plant. Emil Schmidt is president of the company.

L. C. Gahbert and others of St. Joseph, Mo., have organized a company and will erect a malleable plant.

The Warman Brass & Aluminum Co., Cincinnati, recently was incorporated with $25,000 capital, by Roy Warman and others.

The Blackmer Pump Co., Petosky, Mich., will enlarge its plant by the erection of a foundry and other buildings.

An increase in capital from $75,000 to $125,000 has been authorized by the stockholders of the Pettigrew Foundry Co., Harvey, Ill.

Capitalized at $50,000, the Lima Brass & Iron Foundry Co., Lima, O., recently was incorporated by Joseph White and others.

Erection of an addition, 130 x 300 feet, is contemplated by the Ross-Meehan Foundries, Chattanooga, Tenn.

The Moore-Noble Foundry Co., San Francisco, recently was incorporated with $12,000 capital, by J. H. Moore, E. B. Noble and others.

The M. L. Oberdorfer Brass Co., 804 East Water street, Syracuse, N. Y., plans the erection of a foundry addition.

A part of the plant of the Clarksville Foundry & Machine Shops, Clarksville, Tenn., recently was damaged by fire.

Announcement has been made of the sale of the property of the Van Wie Pump Co., including a foundry, to the United States Hoffman Co. The for-

...any, whose offices are at Syracuse, N. Y., ...ans to erect a new foundry and machine shop as ...on as a site can be purchased.

Charles Cunningham, Bristol, Va., is organizing a company with $50,000 capital, to engage in the manufacture of steel castings.

Gibbon & Sexton, founders, Chicago, have let a contract for the erection of a plant addition, 88 x 122 feet.

An increase in its capital from $20,000 to $125,000 has been authorized by the stockholders of the Wadsworth Aluminum Co., Wadsworth, O.

Erection of an addition to its pattern shop, 30 x 80 feet, is contemplated by the Royersford Foundry & Machine Co., Royersford, Pa.

The Columbia Brass Foundry, 732 High street, Los Angeles, has been organized by P. N. Bailey, C. E. Draper and others.

The Shilling Foundry Co., Columbus, O., is reported contemplating the erection of an addition to its plant. Clarence Shilling is president.

A permit has been taken out by the Collinwood Foundry Co., Cleveland, to erect a foundry addition, 25 x 42 feet.

John Deditz, proprietor of the Rhinelander Iron Works, Rhinelander, Wis., plans the erection of a new building for a molding department.

Steel & Radiation, Ltd., Toronto, Ont., is having plans drawn for the conversion of a factory building into a foundry.

The Ruff Malleable Iron Co., Detroit, plans the erection of a plant addition and chipping room, 144 x 232 feet.

Among the recent Ohio incorporations is that of the Sterling Foundry Co., Wellington, O. The company, which is capitalized at $150,000, was incorporated by R. E. Clisby and others.

Capitalized at $5000, the Kent Foundry Co. recently was incorporated at Grand Rapids, Mich., by Harm Enghors, William H. Duffy and Lewis E. Davis.

Frank L. Bridges and Peter Lamberius were named among the incorporators of the Acme Aluminum & Brass Works, Indianapolis, which was recently chartered with $40,000 capital.

Construction of a foundry, 100 x 150 feet, is being planned by the Great Falls Iron Works, Great Falls, Mont. Electrically operated cranes will be installed.

The Southern Pipe & Foundry Co., Knoxville, Tenn., recently was incorporated with $75,000 capital, by F. S. Mead, J. G. Simpson, T. S. Webb, R. W. Brown and Malcolm McDermott.

Incorporation papers have been filed with the secretary of state by the Ypsilanti Foundry Co., Ypsilanti, Mich., which was recently organized with $100,000 capital.

Additions being made to the plant of the Fulton Foundry & Machine Co., Cleveland, will increase its capacity 50 per cent. The extensions include a machine shop, 80 x 160 feet.

The Fate-Root-Heath Co., Plymouth, O., is erecting a foundry, 200 x 300 feet, and a power house and office building. All contracts for equipment have been let.

Erection of a reinforced concrete foundry building is being rushed to completion for the Keystone Foundry Co., Plymouth, Ind. J. E. Fogarty is president of the company.

The Jaeschke Bros. Foundry Co., Thirty-first and Locust streets, Milwaukee, will start work shortly on the erection of plant additions, including a foundry extension, 90 x 150 feet and a coreroom, 50 x 100 feet.

An increase of 100 per cent in the capacity of the A. F. Martin Foundry Co., 705 Park street, Milwaukee, is provided by plans for new construction which include a new core room and molding floor, 8... x 141 feet.

The South Beloit Stove & Mfg. Co., Beloit, Wis., recently was incorporated with $75,000 capital to take over the business of Charles H. Burgess & Son and engage in the manufacture of gray iron castings, stoves, etc.

The W. C. Hunt Mfg. Co., Ltd., Toronto, Ont., recently was incorporated with $40,000 capital to carry on business as iron and brass founders, by William C. Hunt, 59 Paton road, A. C. Crocker, 322 Symington avenue, and others.

Bids will be taken shortly by the Bridgeport Brass Co., Bridgeport, Conn., for the erection of a foundry.

Work on the erection of a $500,000 plant for the Adirondack Steel Foundries Corp., Colonie, N. Y., has been started.

John F. McHenry, 320 Eighth avenue, Wilmington, Del., has plans for the erection of an addition to his foundry.

An addition now being erected at the plant of the Standard Brass Foundry Co., Cleveland, when completed, will house the offices, pattern storage, shipping and cleaning departments. The building now being used as a shipping department will be remodeled as an extension to the molding room.

The Great Lakes Malleable Co., Milwaukee, has awarded contracts for remodeling work and the erection of additions to its plant at 710-716 Reed street, formerly occupied by the Maynard Steel Foundry Co. The new work includes a building, 60 x 65 feet, to be used as an annealing shop. Ray F. Ehler is secretary.

Erection of plant extensions, which include a foundry, 160 x 300 feet, and an engineering building, 130 x 275 feet, has been started at the plant of the Kohler Co., Kohler, Wis.

Ground has been broken at Janesville, Wis., for a foundry for the production of tractor castings for the Samson Tractor Co., a division of the General Motors Corp. The foundry group will include coreroom, sand storage building and pattern shop and will cover an area 330 x 530 feet. Frank D. Chase, Inc., Chicago, is engineer in charge.

The Industrial Steel Casting Co., Toledo, representing a reorganization of the Taylor Coupler & Steel Castings Co., has started on the reconstruction of a building for its increased needs. When completed the work will provide space 120 x 180 feet in addition to the office. Four electric furnaces for producing steel for automobile castings, etc., will be installed. L. S. Dukes is president.

New Trade Publications

FOUNDRY EQUIPMENT—Pouring devices, molding machines, squeezers, and jolting machines are described and illustrated in a 4-page circular being distributed by the Arcade Mfg. Co., Freeport, Ill.

HOSE COUPLING—A newly designed hose coupling is described and illustrated in a folder prepared by the Independent Pneumatic Tool Co., Chicago. This coupling can be disconnected instantly by a straight pull on the knurled sliding sleeves. The bevel jaws and locking shoulders are heavy, with large bearing surfaces and according to the folder, cannot break, jar or work loose. The folder also describes a clamp, designed especially for hose couplings.

STEEL LUMBER—A reference handbook, which should be of especial use to engineers, architects, etc., for their use in designing various types of building construction, is being circulated by the National Pressed Steel Co., Massillon, O. The book is 72 pages in length and is cloth bound. The data given covers a system of construction in steel lumber with structural steel and other materials. Complete specifications of such construction, properties of steel lumber sections, tables of safe loads, construction details and other designing data are clearly illustrated and described.

FOUNDRY FLASKS—The Truscon Steel Co., Youngstown, O., is distributing a 4-page circular in which pressed steel foundry flasks are described and illustrated. The ribs and flanges of these flasks extend the full depth around the corners without buckling or cutting away the metal. The meeting joints are welded. The pinholders are of malleable iron and are securely riveted to the flask. The flange on the filling side is turned outward so as not to interfere with ramming the mold and sand, or hold it when shaken out. The flange on the bottom is turned inward, holding the sand in place when the flask is lifted. One page of the folder describes and illustrates a steel platform for use with lift trucks.

PIPE CUTTER—The Fox Machine Co., Jackson, Mich., is circulating a 4-page folder in which it describes and illustrates its No. 10 pipe cutting machine. The base of the machine is of a cabinet type and contains a tank for the cutting compound, which has a capacity of 1½ gallons. The top of the machine is cast with flange around the outer edge and there are pads on the surface to which are bolted the brackets for supporting the various parts of the machine. The cutter arm is fulcrumed in heavy bearings, which also form the bearing for the main driving shaft. All gears are encased. Cutter disks are of tool steel, and 6 inches in diameter and means are provided for grinding the disk while it is in cutting position in the machine. Three different sized pipe supports are furnished. The position of the cutter can be raised or lowered by turning a crank which extends through the front of the machine. A stop gage which is adjustable for cutting any length of pipe, forms part of the equipment.

PRODUCTION RECORDS—The Pelton Steel Co., Milwaukee, is circulating a 16-page booklet in which colored charts showing the production records of the company during 1916, 1917 and 1918 are given. One chart shows that during 1916 the company's average daily production was 2.34 tons and in 1918 the production had jumped to 11.72 tons. Another chart compares the number of shipments with the number of scrap tons returned. In 1916 there were 171.20 tons shipped while of this amount 5.83 tons or 3.24 per cent returned. In 1918 shipments totaled 3328.58 tons and of this amount 93.11 tons or 2.79 per cent were returned. Other charts given include, combination scrap record; electric furnace heat record and typical customers' shipments and returned scrap for the year 1918.

STEEL CASTINGS—A large cardboard-bound book of 62 pages, containing a pictorial portrayal of the plants at Attica, Ind., and Murphysboro, Ill., of the Harrison Steel Castings Co. and the National Car Coupler Co., and a brief description of their products, is being circulated. Printed on heavily coated stock and well illustrated, the book is a most attractive trade publication. A number of the illustrations are in color. The first part of the book is devoted to a brief history of steel; then follows the history of both companies. This is accompanied by views of the plant, including the interior of the pattern shop, the foundries, the open-hearth furnaces at the Attica plant, the laboratory and other departments. The latter part of the book is devoted to a description of castings made by the companies.

LOCOMOTIVE CRANE.—The United States Crane Co., Chicago, in bulletin 190, recently published, describes and illustrates its line of locomotive cranes, for grab-bucket, hook-block or magnet service. Some of the specifications of these cranes are: Working weight, 139,000 pounds; shipping weight, 120,000 pounds; ballast required, 30,000 pounds; lower frame: 18-inch I-beam with cast steel brackets for spur gear drive mechanism; rotation gear and roller path; rotation rollers; rotating frame; side housings; engines are of the vertical type, double, 10-inch cylinder diameter with 10-inch stroke; boilers of the vertical type, 54-inch diameter, 9½ feet high, 125 tubes, 2¼ inches in diameter; steam pressure 125 pounds to the square inch; water tank capacity, 500 gallons and coal bunker capacity, 2000 pounds. The cranes have a drawbar pull of 9000 pounds maximum, a hoisting speed of 230 feet per minute and have lifting capacities without track clamps or outriggers, of 20 tons at 15-foot radius and four tons at 50-foot radius.

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Compressor Casting Takes 31 Cores

More Than Usual Care Was Necessary in Setting the Cores Accurately For Thickness on Account of the Heavy Air Pressure Which the Casting Must Withstand

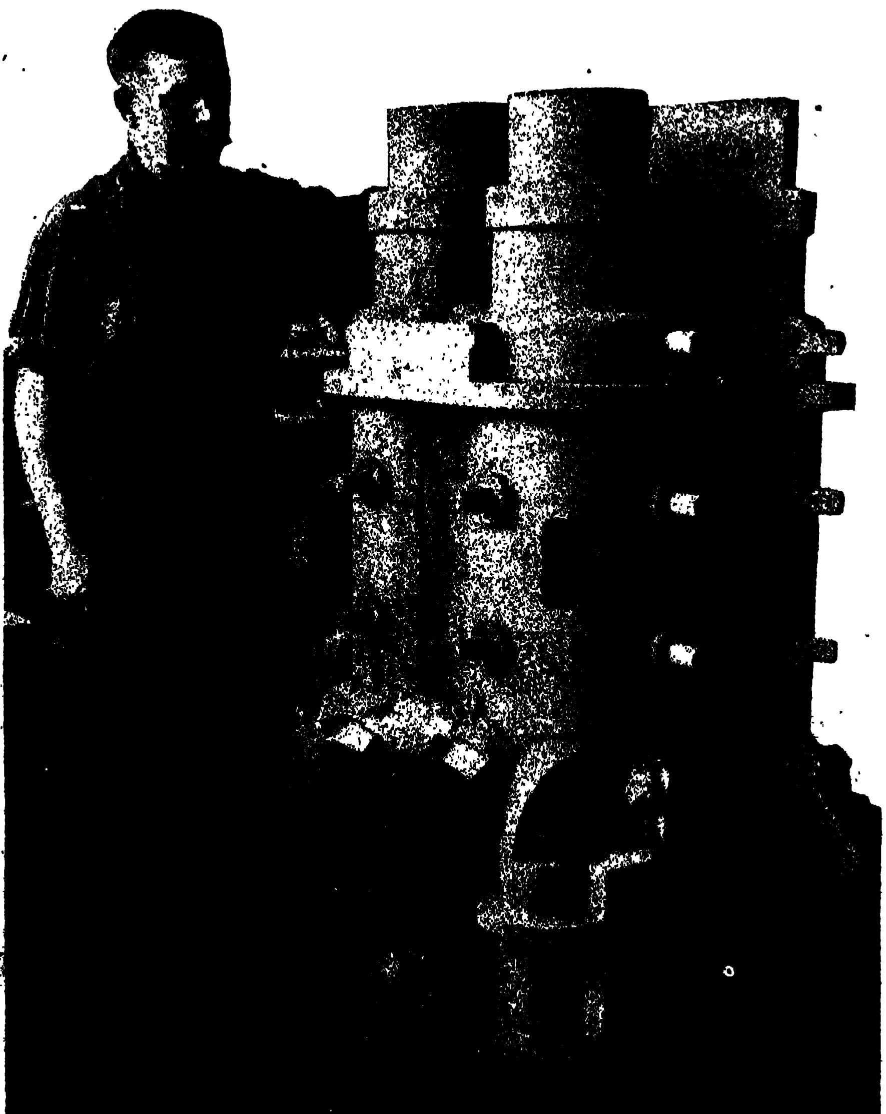

FIG. 1—THE ONLY LOOSE PIECE ON THE PATTERN IS A TRIANGULAR PRINT WHICH FITS INTO THE RECESS SHOWN. THIS PRINT LOCATES TWO BUTTONS WHICH ARE DRAWN AT A TANGENT

KNOWING the conditions under which a piece of machinery will have to operate a good engineer can usually design something to meet the requirements. When it comes to turning that design into something tangible, using some material substance which will answer the purpose intended, manufacturing difficulties frequently present themselves. These difficulties are sometimes of so serious a character that the design must either be amended or abandoned, but when that cannot be done the difficulties are only overcome by the exercise of the highest degree of skill, caution and judgment on the part of the manufacturer.

A problem of this character presented itself to the New London Ship & Engine Co., Groton, Conn., in connection with the construction of submarine engines. In this case the character of the design was rigidly limited and it was necessary, therefore, for the shop to meet the conditions laid down. The problem was encountered in its most acute form in connection with the construction of air compressors for fuel injection which are a necessary part of every diesel engine.

In an engine of standard type, the pressure in the cylinder at the time the fuel must be introduced, is about 400 pounds per square inch and this must not only be overcome by the pressure of the entering fuel, but it must be so far exceeded that the required quantity will pass into the cylinder in about one-sixteenth of a second Experience has shown that

FIG. 2—ALL THE SMALL CORE-PATTERNS ENTERING INTO THE CONSTRUCTION OF THE COMPRESSOR CASTING ARE STRUNG ON WIRES TO PREVENT LOSS

for this work an air pressure of approximately 1000 pounds per square inch is necessary at the spraying nozzle. To provide this air and at the same time keep the weight and size of the compressor within the smallest possible limits, a one-piece casting was designed and made successfully.

Although the molding and general methods employed in the foundry of the New London Ship & Engine Corp. to produce this compressor *en bloc* are in no way radically different from practice in many other plants, still the fact that exceptional care was necessary in every detail and the further consideration that 31 cores are used lends the operation considerable interest as a practical molding problem. During the initial work of preparing the patterns much doubt was expressed on the part of old time foundrymen as to the feasability of the job. Molders and patternmakers, alike, said the piece could not be successfully cast. One man, however, John W. Robertson, in charge of molding operations at the plant, had faith in the design. He entered into the job heart and soul until the conception was a reality. In reducing this job to a practical manufacturing basis, a great deal of experimenting was necessary, but in this article only an outline of the method finally adopted can be presented.

Accuracy is Important

The patterns must be unusually accurate because an even thickness of wall is absolutely necessary for a working pressure of 1000 pounds per square inch. The main pattern for forming the mold is shown in Fig. 1. It is arranged for straight draft and the two halves are nearly identical. Two lugs are located at about the center of the pattern, projecting radially at about 45 degrees to the line of draft. If they were made part of the pattern it would of course be impossible to draw the whole piece without breaking away portions of the mold directly above the lugs; on the other hand if the lugs were made separate, in the form of buttons to be placed on the outside of the pattern it would be difficult to hold them to exact centers and also, being very small, they would easily be lost. To overcome this, the two lugs have been made part of a separate triangular block which fits into a recess in the pattern in such a way that the pattern itself may be drawn leaving the block with its buttons in place.

FIG. 4—THE CASTING AS FIRST TAKEN FROM THE MOLD BY THE CRANE WITH THE RODS STILL IN PLACE WEIGHS OVER 1600 POUNDS

This block, which is shown in Fig. 1, may thus be drawn from the recess at the necessary angle to prevent breaking the mold.

After drawing the halves of this main pattern and finishing the mold, the various cores, one after another, are set in place. These cores are made up in advance in sufficient quantity to offset the possibility of breakage at the time of making the assembly. The core-patterns and all small pattern-pieces are drilled to receive a stringing wire as a means of preventing them from being lost. Fig. 2 gives a good idea of the possibilities of saving time and avoiding the loss of small pieces by this method. It also conserves storage space

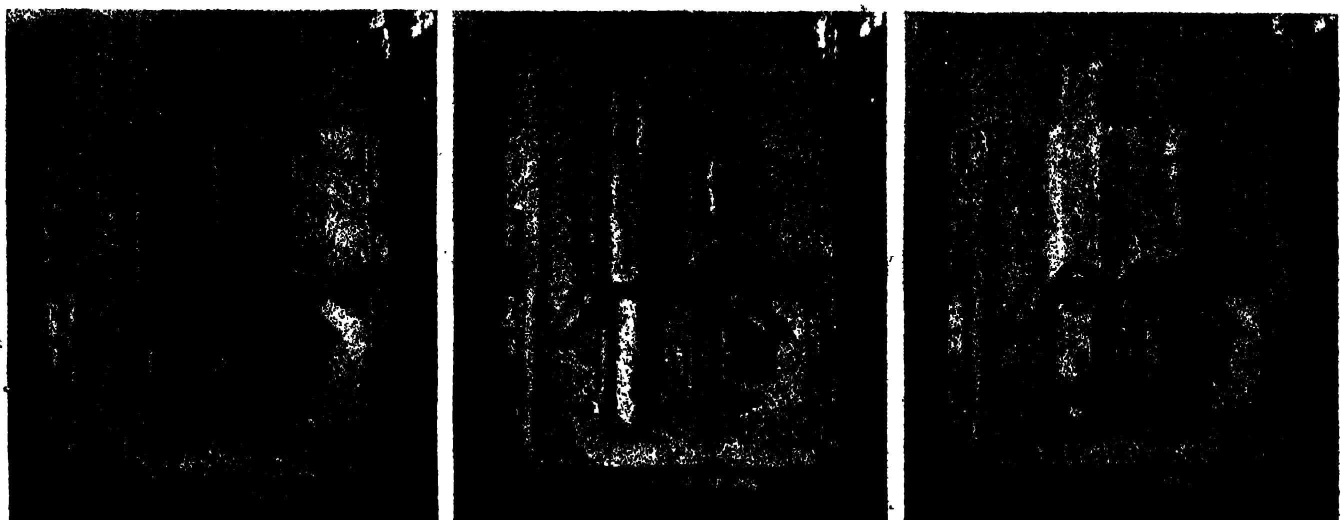

FIG. 3—THESE THREE VIEWS SHOW SUCCESSIVELY THE PLACING OF THE PRINCIPAL CORES. AT THE RIGHT, 31 CORES ARE IN PLACE IN THE DRAG READY FOR THE COPE

Some of the cores used are complicated and require unusual strength. The main water-jacket core is heavily reinforced and when completed is sufficiently rigid to permit somewhat rough treatment without breaking. This core is shown in place in Fig. 3. It is made up in two halves with projecting lugs at the parting. The reinforcing bars extend into these lugs which serve the double purpose of supporting the core and providing a purchase on the reinforcing wires for their extraction after the casting has been poured. The first or lower half of this core is laid in the mold and adjusted to correct position; then the cylinder cores, outlet cores, and other pieces are set in place and the upper half of the water jacket core is placed on top. It is wired to the lower half at the lugs which adds to the strength of the assembly and provides against slipping of one part over another. Finally the cope is lowered into place and the mold is ready to pour.

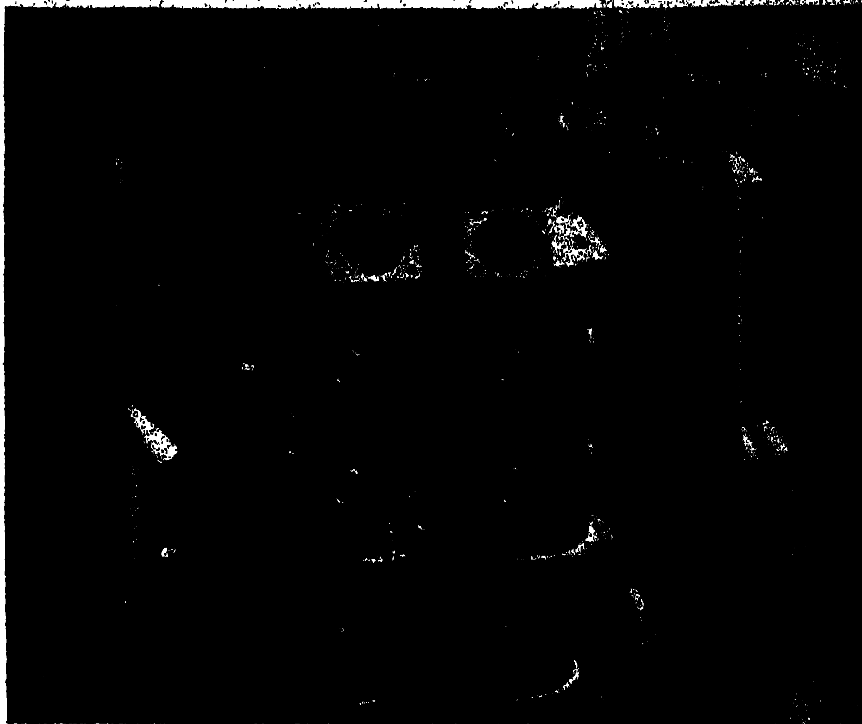

FIG. 5—THE CASTING WHEN COMPLETELY MACHINED BECOMES A THREE STAGE 1000-POUND PRESSURE AIR COMPRESSOR

The pouring is done from the bottom, that is, the gates are at that end of the mold which forms the bottom of the compressor. However, the mold is tipped up with the gates at the top when it is poured. The first portion of metal poured passes into the gate leading to the bottom of the mold (the top of the casting) and the second portion of metal goes through the central gate leading directly to the upper portion of the mold. This is accomplished by means of a pouring basin provided with three runners so arranged that the gate leading to the bottom of the mold may be filled first. The adjustment of many details has been necessary to make this pouring process completely satisfactory.

The metal at the bottom of the mold is under a static head of over 5 feet and some of the sand walls between different sections are only ⅝-inch thick. The casting, as poured, contains about 1600 pounds of iron and about 300 pounds of this are poured in through the gate leading to the bottom. In this way a sufficient quantity of hot metal is at the base of the mold to prevent spattering when the remainder of the metal passing through the central gates, drops in. The thin core walls are reinforced with strainer plates and many surfaces and corners of the mold proper are reinforced with nails and wires.

One important difference between this molding job and many others is the necessity of working to accurate dimensions. All fillets are down to size and the position of the cylinder cores is held to within exceedingly small limits. It can readily be seen

FIG. 6 IT IS A DIFFICULT TASK TO REMOVE ALL THE CORE WIRES. THIS IS DONE WITH SPECIAL HOOKS AND BARS

hat on account of the sloping surfaces between high-pressure stage portions of the cores and the larger low-pressure portions, any longitudinal movement of these cores would mean a variation in the thickness of the separation walls.

When pouring first through the gate leading to the lower part of the mold, the metal drops 5 feet and several precautions are taken to reduce the tendency to spatter and freeze. An elbow is placed in the path of the metal to check its downward velocity and a sullage riser is arranged at the bottom for the purpose of collecting any frozen particles occuring at the initial impact of the metal with the bottom of the drop. Any such impurities tend to be forced to the top of this riser, thus permitting the clean metal to pass directly into the mold through a side tap as shown in Fig. 3. After the pouring has been completed and the casting has cooled it is lifted from the mold by a crane and is transferred to a cleaning room where the cores and core wires are removed. Fig. 4 shows the casting just as it has been taken from the mold.

Core Wires Hard to Remove

Fig. 6 shows the method of removing core wires. It is important to get all these wires and all core sand out of the casting, for any foreign substance would tend to interfere with the circulation of the cooling water. Most of the reinforcing wires are pulled out through openings in the casting by means of pinch bars and other tools. As some of the wires are long and crooked this process is not always easy. Some of the smaller wires run straight from top to bottom and are obtained simply by fishing with a short hook through the holes. Such a hook with the wire which it has caught is shown in Fig. 6. After the removal of all the core material the casting is cleaned up in the usual way and sent to the machine shop.

A view of a completed set of cylinders made from this pattern is shown in Fig. 5 together with the two pistons. Inasmuch as this casting job has some features unique in foundry practice a few of the details concerning its production will be given. The sand used is made up of 33⅓ per cent Jersey molding sand, 33⅓ per cent floor or heap sand and 33⅓ per cent of Cape Cod sand. This latter is a sand found on the beach at Cape Cod. It takes the same shipping rate as common sand. The whole mixture is mulled up and while in the mulling machine is tempered with clay water. The mold is baked before pouring and becomes so hard that a barefoot man could step upon any part of it without causing injury. The iron mixture used is low in silicon and its composition is as follows:

	Per Cent
Silicon	1.35
Sulphur	0.075
Manganese	0.70
Phosphorus	0.30
Carbon	2.50

The castings must have a high ultimate strength and are not accepted unless the specimens test between 30,000 and 40,000 pounds tensile strength and between 3000 and 4000 pounds transverse strength. The cores are all bonded with linseed oil. The water jacket core is heavily reinforced. Each half has twelve ¼-inch wires running from top to bottom and equally spaced throughout their length; that is, they start from the narrow part at the top of the high pressure cylinders and spread in conformity with the general shape of the core where it surrounds the large cylinders. In each half of the core nine cross wires run from the lugs on one side to those on the other side, three being brought out at each lug. These wires spread apart as soon as they leave the lugs and together with the 12 longitudinal wires form a basket-like network. Where the wires cross they are fastened together with pieces of small wire.

Strict instructions are given that there shall be no filing or rubbing of the cores to correct defects. If the cores are not correct as they are made they are thrown out. The wires are covered with flour paste to insure a good bond with the sand. The work being very accurate, it takes one man eight hours to core up the mold; the mold itself requires two men eight hours for ramming and two men another eight hours for finishing. It takes one man eight hours to remove cores and core wires from the completed casting.

The entire job while at first treated with a great deal of caution, has now become part of the foundry routine. The amount of loss in the foundry is barely 10 per cent, and when the necessity for correctly placing 31 cores is considered, this is seen to be moderate.

Foundry Contract Let

C. W. Sherman, associated with the Dominion Steel Co., Hamilton, Ont., is president of the Adirondack Steel Foundries Corp., Colonie, N. Y., which has awarded a contract to the Crowell-Lundoff-Little Co., Cleveland, for a new $300,000 steel foundry.

New England Foundrymen Meet in Boston

The New England Foundrymen's association held its first fall meeting at the Exchange club, Boston, Wednesday, Sept. 10. A. O. Backert, president of the American Foundrymen's association, was the principal speaker of the evening, and his description of conditions in Europe was of special interest to New England manufacturers, nearly all of whom have export questions in mind. Mr. Backert, who has recently made an inspection tour through the iron and steel district of England, told of the sympathy between the nations.

To illustrate the size of some of the English industries, Mr. Backert pointed out that one plant which he visited, turned out 25,000 tons of malleable iron per year. In many plants he found idle electric furnaces. The reason for this being that the extremely high price of electric power has made it impossible to continue the operation of these furnaces which were put in during the period of production frenzy, brought about by the war. Converters are used freely and a common installation includes a cupola mounted high enough so that metal flows by gravity directly into the converter. Mr. Backert stated that even now, under the crippled condition of Germany, with the whole Alsace-Lorraine district in French hands, that country still is second in pig iron production.

The franc, normally worth less than the German mark, now has a purchasing value in Germany of about three times its prewar value. In other words, for twenty cents in French money something over 60 cents worth of German goods can be purchased and how ever strong may be the sentiment against buying from Germany, it can hardly be expected to overcome the great advantage obtained through the difference in exchange.

Organize New Company

The Vibrating Machinery Co., capitalized at $50,000, has been organized and chartered at Chicago, and has taken over the entire business of the Schroeter Engineering Co., establishing a plant and office at 546 West Jackson boulevard. Julius Schroeter is president of the new concern, F. Von Schlagell is treasurer and Mrs. J. C. Miller, secretary. The company manufactures an oscillating foundry riddle and a gas unit for welding and cutting. The latter device is just being put on the market and is designed to use natural or city gas in connection with oxygen.

Experts Discuss Pulverized Coal

Design of Burner and Kind of Coal Used are Important—Economy Shown in Annealing Malleable and Tests With Powdered Coal on the Air Furnace are Recorded

FOR a number of years powdered coal has been used successfully for firing malleable-iron annealing furnaces, and recently a number of foundries have equipped their melting furnaces with apparatus for burning this type of fuel. While the data obtained so far have been too meager to warrant definite conclusions, the introduction of powdered coal into malleable-iron melting furnaces is without doubt being closely watched by producers in the hope of finding a means of dispensing with some of the labor required for the ordinary system of coal firing. For this reason the symposium of papers on the use of powdered coal presented at the annual meeting of the American Foundrymen's association in Philadelphia Oct. 1 is of special interest. Papers were presented by Charles Longenecker, the Bonnot Co., Canton, O.; A. J. Grindle, Combustion Economy Corp., Chicago, and Milton W. Arrowood, Ground Coal Engineering Co., Chicago. Mr. Longenecker gives data on an installation of powdered coal burning equipment on malleable-iron annealing furnaces which shows a cost of $2625 when using powdered coal, against $4900 for doing the same amount of annealing with natural gas and $8400 when using fuel oil. At another foundry a saving of 48 per cent has been effected in the quantity of coal consumed when it was used in the powdered form. The question of melting malleable iron in the air furnace with powdered coal is taken up by Mr. Arrowood. This question is not solely one of cost, but involves the effect of the flame and the ash from the coal on the metal and on the brickwork of the furnace. Not enough data have so far been secured to warrant definite conclusions but much information on the subject has been added by Mr. Arrowood's paper. That steel is being melted with 450 to 600 pounds of powdered coal per ton of charge and that 15 malleable foundries using powdered coal for annealing have a fuel ratio of from 500 to 700 pounds of coal per ton of castings is shown by Mr. Grindle. He also gives analyses of different coals which have proved satisfactory for use in the powdered form.

Develop Firing System For Air Furnace

BY MILTON W. ARROWOOD

VOLATILE pulverized fuel is highly combustible when dry, and if injected into a furnace at ignition temperature will ultimately burn as it finds air. But it is not believed that the highest efficiency is possible except where the greatest care is taken to introduce the air and fuel into the furnace as a completely diffused mixture. All problems calling for rapid and wide diffusion, whether it be a bursting hand grenade or the mere breaking up of a dust body call for action from the inside out.

A burner which has been designed to develop action of this kind is shown in Fig. 1. The powdered coal is fed by a screw feed into a perforated drum, *B*. Here it is met by a current of air blowing down on it from the pipe, *A*. The air and coal mix in this drum and are further mixed as they pass through the perforations and strike the walls of the encasing chamber, *C*. From this chamber they pass through the pipe, *D*, into the main chamber of the burner, which contains two or more sets of mixing shells concentrically arranged. In this chamber the main body of air is introduced through the conductor, *E*.

Having this type of apparatus, arrangements were made to conduct a series of tests on an air furnace at a plant in Meadville, Pa. Owing to some misunderstanding as to the method to be used in controlling the top blast, the original burner installed was designed to admit half the air at the top blast and take the remainder through the burner. This sacrificed at least half the mixing efficiency of the apparatus. A 14-inch duplex burner was used, capable of taking air enough for mixing and burning 1200 to 1500 pounds of coal per hour and a proportionately greater amount according to the amount of air admitted at the top blast. Pulverized coal was purchased from an outside plant, being that used ordinarily for annealing. It analyzed as follows:

	Per cent
Sulphur	1.34
Volatile matter	35.32
Fixed carbon	50.80
Ash	12.45
Moisture	1.43

Air was supplied by a No. 7 Sturtevant fan at a pressure on the fan outlet of five ounces, the line running some 40 feet to a Y-division supplying the two parts of the burner. The existing branch of the line supplying air to the ash pit was not disturbed. The burner was first lit with the furnace empty, the total air pressure at the burner being 8 inches and at the overhead blast pipe 4.25 ounces (difference due to pipe layout). The furnace was operated on this basis for 2 hours 12 minutes, the average coal fed being about one ton per hour.

At 1 hour and 20 minutes from starting time, a pig of iron was placed in the rear side door of the furnace and another in the front door. These were dripping freely in eight minutes. When feeding the full amount of coal, combustion was not complete until the flame came in contact with the top blast just over the bridge wall. Thus the principal heat zone was too far in the rear of the furnace. Coal was filled into the hopper by hand from bags of known weights, the amount of coal left at end of run being deducted. It was found that the feed screw had been delivering 0.3 pound per turn. The furnace was built for a charge of 10 to 12 tons.

The following day, a 2-ton charge made up of pig iron, hard scrap and railway malleable, showing an average of 0.914 per cent silicon and 0.627 per cent manganese was put in the furnace, which was then fired, without skimming bath, for 3 hours and 29 minutes, when the iron was poured, the fire being continued for 15 minutes while tapping out. A total of 5914 pounds of coal was used, or say three tons of coal for two tons of iron. The general character

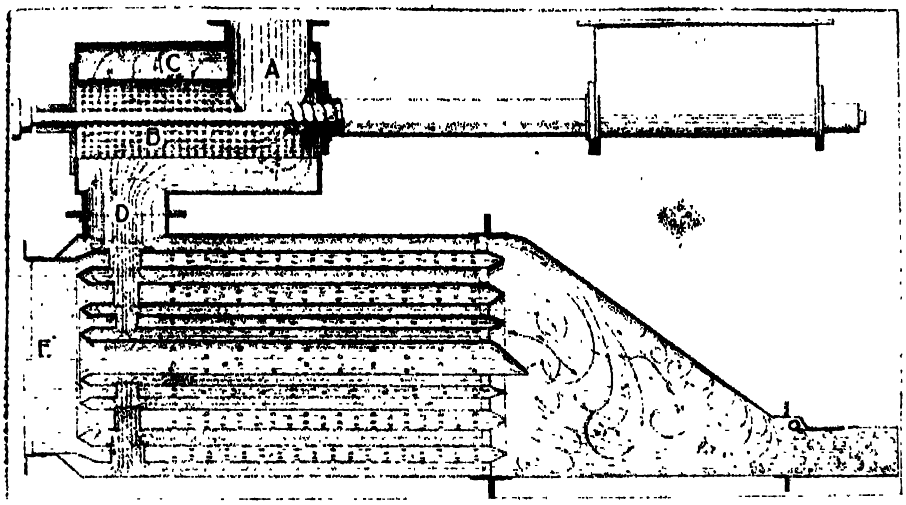

FIG. 1 BURNER DESIGNED TO THOROUGHLY MIX POWDERED COAL WITH THE AIR WHICH BURNS IT

of the metal was satisfactory but it was necessary to leave considerable slag in the furnace, owing to the condition of the bottom and the tap holes.

The brick covering that had been placed over the grates was removed at the bridge wall across the fire box for a space 1 foot wide lengthwise of the furnace. This made it possible to admit air through the ash pit under the fire in regulated amount. A 4 ton charge showing 0.902 per cent silicon and 0.62 per cent manganese was charged on the following day and on starting the fire it was at once seen that the large volume of air rising at the bridge wall deflected the flame to the roof and formed a cold blanket on the bath, thus making a slow heating furnace. The rear bridge wall had been built up two courses of brick and after running one and a half hours it was decided the fire was choked too much. Twelve minutes were lost in removing some of the brick, after which the fire was continued for a total of 5 hours and 52 minutes, including a short shut down to replace bung. The roof showed distress while the bath showed dull, attributed to the air condition above mentioned. Owing to the short charge it was not possible to skim the heat effectively, although it was partially skimmed after four hours. The total coal consumption was 10,300 pounds or 5.1 tons for four tons of iron melted in a 12-ton furnace. A test bar poured at 4 hours and 40 minutes showed silicon, 0.54 per cent, sulphur 0.102 per cent, phosphorous, 0.131 per cent, and combined carbon 3.50 per cent.

The opening over the grates was filled up and the eight 2-inch tuyeres on top blast were changed to 3-inch, the floor of combustion chamber was filled up to within 10 inches of top of front bridge wall. The outer end of the burner was raised and the discharge pointed at a downward angle against the front end of the charge. The burner was then lighted on the empty furnace for 1 hour and 15 minutes, it being desired to start a charge with a hot furnace. A 5 ton charge of the same composition as the previous heat was then fired for 4 hours and 55 minutes, with shut down of 5 minutes on account of the loss of a bung. The total coal fed was 9088 pounds or an average of 1725 pounds per hour, or a total of 4.5 tons for 5 tons of iron in a 12-ton furnace, with a considerable amount of slag left in the furnace from previous heats that could not be skimmed properly. The quantity of metal was sufficient to permit fair skimming and at 3 hours and 30 minutes a considerable amount of slag of good appearance was skimmed off. At 4 hours and 10 minutes a test bar showed 0.73 per cent silicon and 0.958 per cent sulphur, while a second bar poured at tapping out 4 hours and 40 minutes from starting showed as follows:

	Per cent
Total carbon	3.20
Combined carbon	2.78
Graphitic carbon	0.42
Manganese	0.30
Phosphorous	0.155
Silicon	0.98
Sulphur	0.06

A test bar poured from a ladle taken off during tapping out showed 0.68 per cent silicon, 0.081 per cent sulphur and a tensile strength of 35,600 pounds. Another analysis from pig, taken in same way, showed as follows from a different chemist:

	Per cent
Silicon	0.67
Sulphur	0.048
Manganese	0.44
Combined carbon	1.55
Graphitic carbon	1.20

Analysis of iron from hand fired furnaces in the same plant showed as follows:

	Per cent
Silicon	0.59
Sulphur	0.092
Phosphorous	0.150
Manganese	0.26
Combined carbon	2.97
Total carbon	2.98

As a result of this test, it was conclusively shown that all of the air should be admitted through the burner and arrangements were then made to set up a burner of sufficient capacity for this purpose. At the time of preparing this paper for presentation reports on additional heats have not become available. It is hoped that further data will be available later.

A 30-inch burner has been installed on a furnace, built for a capacity of 10 to 15 tons in a prominent foundry in Erie Pa. A view of the burner attached to this furnace is shown in Fig. 2. Acting on the idea of having the initial com-

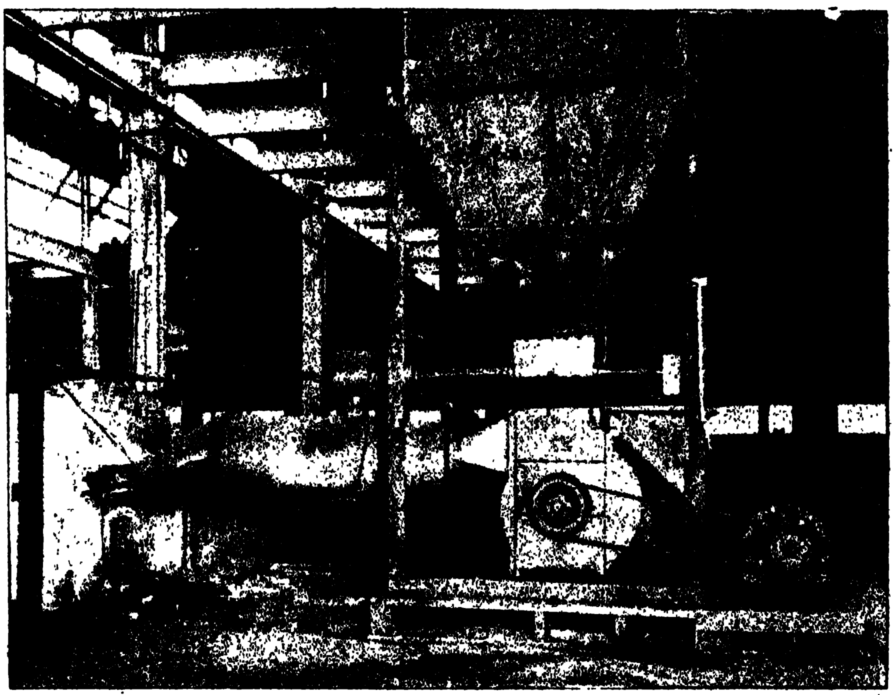

FIG. 2—POWDERED-COAL BURNER ATTACHED TO AN AIR FURNACE

bustion occur on the front end of the charge, the combustion chamber was made only about 2 feet in length from the noze of burner to the front bridge wall. For reasons noted, this proved to be unsatisfactory and it was considered desirable to lengthen the combustion chamber about 7 feet, thus completing combustion by the time the gases reach the bridge wall so that the extremely hot gases come in contact with the charge.

This lengthening of the furnace, together with other minor changes and adjustments, as well as insufficient mill capacity to supply coal for full time operation, and the fact that the conveying system from the mill to furnace hopper has not been installed, caused delay in placing the furnace in regular operation. It is contemplated to put this unit in daily service as soon as circumstances permit.

In malleable iron annealing, the powdered-coal burner performs functions equally as satisfactorily as in the air melting furnace. For greatest economy in the use of pulverized coal, the ovens should be of comparatively large size. It then becomes a problem of uniform heat distribution and control so as not to burn the pots. With some types of pulverized coal burners it is found that the heat is thrown in too great degree toward the front end of the ovens. At times the poor heat distribution with high velocity burners results in burning top pots near the burner, while the bottom ones on the same stools may not be annealed. Where a cutting flame cuts down the brick on the firebox, the destruction of pots near the burner may be aggravated from slag deposition and fluxing. At other times, if the coal happens to be a little damp or not ground as fine as usual, some of it may be deposited on the floor and blanket the bottom pots near the burner.

While no commercial installation has yet been made on the muffle type of annealing oven, a number of test runs were made on such an oven handling railway castings. In a plant having 26 ovens of a capacity about 25 tons each, the practice with hand firing was to secure one pound of castings annealed per pound of coal. An improved form of oven was constructed and on a specially conducted test showed a ratio of 2.2 to 1. A 6-inch powdered coal burner on the same oven showed a ratio of 5.2 to 1 and the test record of flue temperature (presently to be mentioned) indicated that the length of this oven could be increased 6 feet without using any more coal, in which case the ratio would be 7.25 to 1. The difference between 1 pound of castings and 7.25 pounds per pound of coal is shown to be very great. On this basis 14 ovens will do the work of 12 and there is a capital saving of $24,000 besides space released for several molding floors, etc.

The total time of firing, however, was 49.5 hours as compared to the usual hand firing period of 90 to 110 hours on the same ovens. The special hand-fired test showing ratio of 2.2 to 1 was made in 72 hours firing time. The total coal consumption on this run was 9650 pounds and 25 tons of castings were annealed, making the ratio 5.18 to 1. The castings were of excellent quality.

Powdered Coal for the Small Foundry

BY A. J. GRINDLE

THE use of powdered coal for fuel has interested foundrymen, manufacturers and engineers for over 100 years, but until the last few years its practicability has been doubted by most engineers owing to the great number of failures which have been made in its preparation and burning.

In malleable and steel foundries using 10 tons of coal per day, or its equivalent in oil, gas or coke, the use of powdered coal for fuel is practical in the opinion of the author. There are several open-hearth furnaces now using this fuel; steel is being melted with 450 to 600 pounds of coal per ton of charge. There are about 15 malleable foundries using powdered coal for annealing, the fuel ratio on these ovens being from 500 to 700 pounds of coal per ton of castings; much time is being saved in bringing the ovens up to annealing temperature. Malleable iron has been melted with 31.2 per cent coal to iron, a 12-ton heat being melted in three hours and 40 minutes with a ton more scrap than usual in place of pig iron.

Steam boilers are being fired with powdered coal and 8½ to 11 pounds of water per pound of coal are being evaporated. If a foundry is equipped with a powdered coal plant it is practical to fire the core ovens with this fuel.

In addition to the fuel saving and savings effected in decreased oxidation of the metal, I believe a saving of 25 per cent to 75 per cent in labor can be made. A uniform temperature can be maintained and therefore a uniform product. Core ovens and steam boilers can be equipped with a thermostatic control and the heat controlled as easily as with gas.

Heretofore the small foundry could not use powdered coal for annealing owing to the high cost of an installation compared with the possible savings, but now it is practical for even the small foundry, since it can be used in all departments where fuel is consumed.

Feeding and Burning Coal

No matter how well coal is dried and pulverized, proper combustion cannot be secured without a uniform feed of coal, thorough carburization with air, and means of easily and accurately controlling the coal and air supply. Equipment has been perfected which overcomes many of these difficulties.

Powdered coal has a tendency to pack in the storage hopper, especially when it stands a few days before burning, and if the opening in the hopper bottom is too small the coal will arch over the feed screw and stop the fuel supply. This trouble has been corrected by a specially designed feed screw enclosed in a cast-iron hopper bottom with a large top opening. This feed worm will feed throughout its full length. The coal gradually loosens up toward the discharge end in place of packing. At the discharge end there is a revolving disk which breaks up any packing of coal which might take place along the feed screw. Packing causes an unsteady feed of coal and a pulsating flame, but it is believed this system eliminates this fault and produces a uniform feed, resulting in a steady continuous flame.

Coals best suited for burning in a powdered form are those rich in volatile matter, such as bituminous and semi-bituminous, either slack or run-of-mine. The slack has an advantage over the run-of-mine as it is not necessary to crush the former before drying.

The following analysis represents a coal which has been found to give good results on melting furnaces:

	Per cent
Fixed carbon	60.12
Volatile matter	35.80
Ash	3.08
Moisture	1.00
Sulphur	.38
B.t.u.	14,050

Good results have been obtained in annealing ovens and steam boilers from coal of the following analysis:

	Per cent
Fixed carbon	53.20
Volatile matter	29.00
Ash	16.34
Moisture	1.40
Sulphur	1.80
B.t.u.	12,600

Qualities of anthracite lignite and peat, as well as the inferior grades such as anthracite culm, dust and slush, and bituminous and lignite slack screenings and dust are all suitable for burning in pulverized form, for certain kinds of work, when dried and properly mixed with a higher volatile fuel. For the proper igniting and burning of powdered coal the volatile content should be 20 per cent or more, while the quality of the fuel is an important consideration the conditions under which it is burned are more so.

The cost of preparing powdered coal for burning runs from $0.46 to $1.00 per ton depending on the amount pulverized. The cost of an installation runs from $18,000 to $150,000 according to the capacity and number of the furnaces to be fired.

Using Pulverized Coal for Annealing

BY CHARLES LONGENECKER

THE first installation of powdered coal burning apparatus on malleable iron annealing furnaces was at the plant of the Erie Malleable Co., Erie, Pa., where B. J. Walker adopted this method of heating in 1896. Since that time numerous other installations have been erected. The Pressed Steel Car Co., Pittsburgh, formerly the Pennsylvania Malleable Co., made its initial application of powdered coal to annealing furnaces in the fall of 1917, and since then these furnaces have been in continuous operation. In this plant each air furace is practically all below the floor level. There are 10 large and 18 small furnaces, some of which are used for annealing steel castings. The larger ones have a capacity of 50 tons, while the smaller hold 25 tons. Fig. 1 shows a longitudinal cross section of the large furnace and Fig. 2 a transverse section.

As is well known, the requisites in an annealing furnace from a thermal standpoint are a uniform temperature (and consequently heat) throughout the heating chamber and the maintenance of a constant degree of heat for the proper length of time. To secure these conditions, it was necessary to install four burners in each furnace and maintain a steady flow of coal to these burners. The following table shows a typical run and illustrates how well conditions have been met:

July		
10	Noon, furnace lighted.	
11	1600° (6 A. M.)	1630° (6 P. M.)
12	1640° (6 A. M.)	1620° (6 P. M.)
13	1620° (6 A. M.)	1600° (6 P. M.)
14	1640° (6 A. M.)	1620° (6 P. M.)
15	1620° (6 A. M.)	1640° (6 P. M.)
15-16	1620° (9 P. M.)	1640° (3 A. M.)
16	1620° (6 A. M.)	

From the foregoing we obtain the following summary:

Furnace lighted, July 10, noon.
Time to bring furnace to temperature 1600 degrees, 18 hours.
Furnace held at temperature, 1600 degrees, 120 hours.
Firing discontinued, 6 a. m., July 16.
Bungs (roof) removed, 6 a. m., July 18.
The castings were then removed as soon as they were cool enough to handle.

A pyrometer is inserted in each end of each furnace. Each one is connected to a central instrument. It is the duty of the furnace attendant to read the temperature of each furnace at frequent intervals on this instrument, so that there is little chance for any wide fluctuation in temperature. One attendant supervises all the furnaces.

With powdered coal it requires from 14 to 18 hours to bring the furnace to 1600 degrees, with fuel oil the time is 22 to 24 hours, and with natural gas about 26 hours. From the foregoing it seems apparent that powdered coal gives results which are thermally satisfactory.

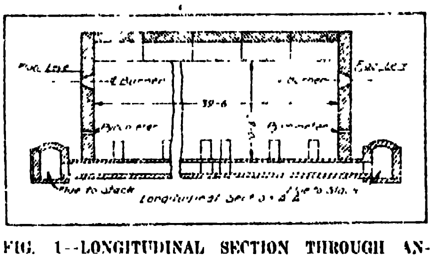

FIG. 1—LONGITUDINAL SECTION THROUGH ANNEALING FURNACE AT A-A, FIG. 2

There is an accumulation of fine ash which must be removed from these furnaces at intervals. The length of these intervals will depend on the percentage of ash in the coal. When the coal has a low ash content the accumulation is removed once a month. In the standard type of furnace, where the heating chamber floor level is at general floor level, the disposal of ash is of small moment, due to greater accessibility of both heating chamber and flues.

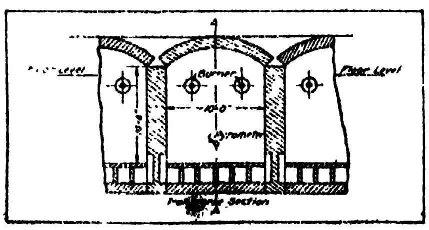

FIG. 2—TRANSVERSE SECTION THROUGH ANNEALING FURNACE

As is well known, in annealing malleable castings a fluctuating temperature must be avoided and at no time is it permissible to allow the temperature to fall below the critical range. To secure this control of the heat requires close regulation of both the fuel and the air to burn it. No trouble has been encountered in holding these conditions constant.

A comparative record of costs for three fuels is as follows:

Natural gas, 14,000,000 cubic feet, at 35c per 1000, $4900; fuel oil, 105,000 gallons at 8c, $8400; powdered coal, 525 tons at $5 per ton, $2625.

The figure $5 given as the cost of powdered coal includes besides the coal all labor, power, etc. These costs are taken from actual practice and cover three separate months during each of which one of these fuels was burned.

In another malleable iron foundry where powdered coal is now burned in the annealing furnaces, a saving of 48 per cent has been effected in the quantity of fuel consumed. In this case the amount of powdered coal burned per ton of output is 450 pounds. The time to bring the furnace to temperature has been reduced from 24 to 36 hours, required for hand firing, to 11 to 14 hours. When hand fired, there was always a difference in temperature in these furnaces of from 200 to 300 degrees between the front and rear. Today, when fired with powdered coal, this temperature appears to be uniform. This is accounted for by the fact that the pressure in the furnace is equalized, as it is impossible to obtain a uniform temperature throughout the chamber unless the furnace is under a slight pressure. With stack draft and hand firing it is exceedingly difficult to avoid pulling in some cold air, especially at the door. This makes a cold streak and naturally it is impossible to secure a uniform temperature under such conditions.

Besides malleable castings, the Pressed Steel Car Co. also manufactures steel castings. They are an-

nealed in the same furnace as the malleable castings. The temperature carried when annealing steel is 1660 degrees Fahr. One of these furnaces was lighted at 3 p. m., July 15, and firing discontinued at 11 a. m., July 16, so that the total time required for the annealing was 20 hours. The coal consumption was 140 pounds per hour.

Fig. 3 shows the tops of the furnaces and the pipes through which the coal and air are delivered to the burners. The large spiral riveted pipe on top carries the coal, while the secondary air flows through the lower one. Two-inch wrought iron pipes branch from these. The latter are connected at their upper ends to the control valves, shown in the illustration, which regulate the flow of coal and air to the burners. Their lower ends terminate at the burner.

The coal which passes through the upper pipe is of course very fine, as it must be held in suspension throughout the length of the pipe. The principle of distribution is as follows:

The coal is received in cars and after being dried is pulverized and then conveyed pneumatically to a substation at the foundry building. Here it is separated from the high pressure air and falls into a 25-ton bin. Two spiral screws feed the coal from this bin into a pipe connected to the suction side of the fan. This fan has a capacity of 6000 cubic feet of air per minute. In the fan the fine coal is mixed with air in the proportion of 1 pound of coal to 60 cubic feet of air. This mixture is then forced through the pipes and delivered to the burners as desired by the furnace attendant. As is well known, it requires at least 200 cubic feet of air to form a combustible mixture with one pound of coal that is burned.

There is, therefore, no danger of combustion until the necessary additional 140 cubic feet has been added at the burner. The ratio of 1 pound of coal to 60 cubic feet of air is maintained automatically by a very simple electrical contrivance. If desired, the ratio can be changed and the machinery set to hold it constant.

The Globe Foundry Co., Sheboygan, Wis., recently has been incorporated by G. F. Honold, Gus A. De Wilde Jr. and Fred Leicht. The new company will take over the Globe Co., and will extend its facilities by the construction of a new gray iron foundry. The present foundry will be converted into a machine shop to handle general machinery manufacture.

Why Facing is Necessary

Foundry facings are applied to the surface of molds for the purpose of preventing adhesion between the metal and the sand of which the mold is composed. When the facing performs this function properly, a casting is secured which requires little or no cleaning, thus effecting a great saving in the operating expenses.

The saving is not confined to the item of cleaning, but also appears in the reduced cost of machining due to the absence of burnt sand on the surface of the casting. When facings of the better quality are used, the sand is used quite dry. It is common experience that facings used during the summer months with the utmost satisfaction, are found fault with when winter months come, because they don't slick well. This is most often experienced in foundries which are not well heated and which become unusually damp in cold weather. The sand does not dry out so rapidly as in the summer, and is consequently just a little damper when used. This accounts for a difference in the working of the facing.

There are four general classes of work that require different facings: Green sand, loam, dry sand and cores.

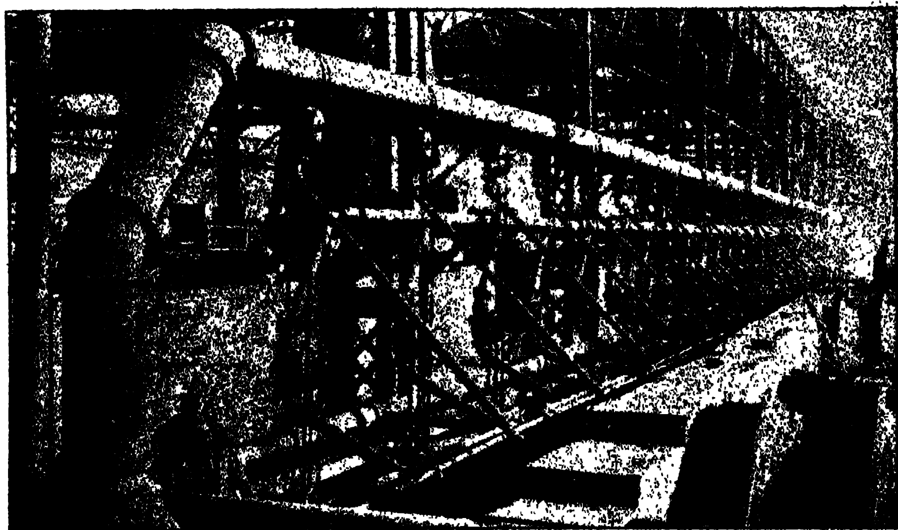

FIG. 3—VIEW ALONG TOPS OF ANNEALING FURNACES SHOWING PIPES FOR CARRYING AIR AND POWDERED COAL

castings are of that fine bluish gray color so much desired by the progressive foundryman.

The reason why a graphite or *silver lead* facing prevents the sand adhering to the metal is as follows:

Graphite is one of the forms of carbon and is a combustible material. When molten metal is poured into the mold, the air in the mold and the air carried in by the stream of melted metal furnish oxygen enough to bring about a certain amount of combustion, forming a gas between the metal and the mold. This effectually prevents adhesion of the metal to the sand, and just as long as the gas film exists no adhesion can possibly occur.

Pure graphite will not adhere of itself to the mold surfaces, but will run before the metal the moment the sand dries. To prevent this, it is necessary to add a binder to hold it in place. The proper proportioning and selection of this binder is a matter of the utmost importance. Facings with a large percentage of binder are more difficult to slick than those with a low percentage. Therefore they are indicated where the

Green sand molding is by far the most common, and is used for nearly all iron molding done in flasks. *Green sand* means damp sand that can be packed sufficiently hard to retain its shape. Facings are dusted on, and slicked by hand.

Dry sand molding differs from green sand in that after the mold is finished, the flasks are placed in a drying oven and thoroughly dried. Facing for dry sand is mixed with water and applied to the hard surfaces as a wash.

Core work. If the casting is to be hollow, a core of the proper form is suspended in the mold, so that after metal is poured the core can be knocked out and leave a hole of any desired shape within the casting. Cores are commonly made of flinty sand mixed with some kind of binder and baked hard. They are then coated with a graphite wash, the same as for dry sand work.

Good castings depend largely upon good facings, or at least good castings are impossible with poor facings. On the other hand, it is necessary that the facing be available at a reasonable cost consistent with quality.

Machining Qualities of Malleable

Cutting and Drilling Tests Were Made on Malleable Iron Samples With Different Physical Properties to Determine Relation of High Elongation and Tensile Strength to the Machinability of the Metal

BY EDWIN K. SMITH AND WILLIAM BARR

DURING the past year or so, there has been considerable discussion of the machining qualities of malleable castings. At the same time there has been a decided tendency toward raising the physical characteristics, especially the tensile strength and elongation. This naturally has brought up the question: "What effects have the higher physical properties had on machinability?" There are wide differences of opinion in regard to this, and as the subject is of importance to manufacturers, as well as to users of castings, it seemed advisable to collect the available data, in order to present at least a preliminary report at this time. On getting in touch with various foundries, it became evident that there are two general opinions, and that practically every concern has a strong leaning toward one or the other of these opinions.

Opinions Differ

One set maintains that machinability is practically independent of physical characteristics, and that castings showing high tensile strength and elongation machine quite as well as those with lower physical properties The other group feels equally strongly that in certain lines of work, where extremely high strength is not necessary, greater ease and speed of machining can be obtained by using a metal with lower physical characteristics. There is no question as to what metal to make when great strength is the one essential requisite.

There is little literature on this subject. A paper presented at the American Foundrymen's association convention in Boston in 1917 recommends the manufacture of malleable with high characteristics, but admits that with such extra good material, the user may have to increase the strength of his machine tools, and decrease the cutting speed.

Another noted authority wrote: "In looking over these records, it is only fair to consider, that included in them are bars from concerns in which high strength and ductility have been sacrificed, in order to secure such a character of metal, as would machine with the greatest ease, this property in these particular cases being the predominating requirement." Also "One thing is certain, that as in the case of steel, the malleable iron casting that machines most kindly, is as a rule, the one poorest in physical properties."

Theoretically it would seem probable that a high tensile strength in

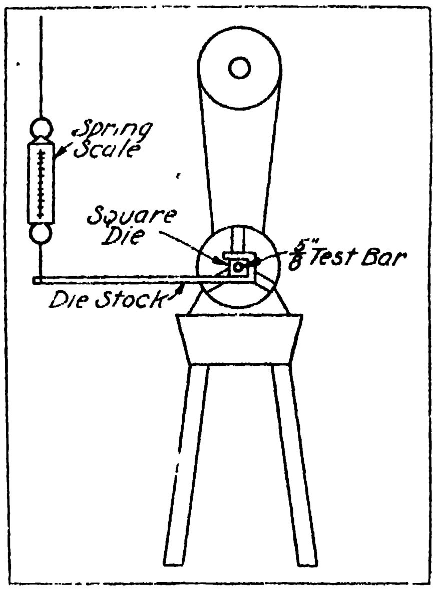

FIG. 1 END VIEW OF MACHINABILITY TESTING MACHINE

any metal, would increase difficulty in machining, if we consider that the tensile test consists of tearing apart the particles of iron, until the bar is fractured, and that a good part of the action, of any cutting tool, consists in a similar tearing apart of the particles of iron.

In order to obtain the ideas of those whose experience would qualify them as judges, we wrote a number of malleable foundries, and the replies showed considerable difference of opinions. A few quotations will suffice:

1—"Very high tensile strength and high elongation malleable machines quite well."

2—"Iron of 50,000 or 55,000 pounds tensile strength, with elongation 12 to 16 per cent is easily machined; 100 per cent of this iron is machined at high speed—without the least trouble."

3—"There is no question but that very high tensile malleable iron will not answer for the small castings on which a great deal of finishing is done—where the quantity finished per hour is a matter of prime importance. High tensile material is a necessity for car work."

4—"Unless we were able to do this (vary our mixture) our tool cost for machining these castings would in some cases be enormously increased."

It is rather significant that the product of manufacturers of light castings, especially those extensively machined, as a rule, averages considerably lower in physical tests, than that of makers of heavy castings, although both classes of castings give excellent results under actual service conditions.

The Test of Practice

It is particularly noticeable that the majority of concerns which both make and machine certain lines of small castings, prefer a metal of medium low test, as they find that the strength of this metal is ample, and machining qualities superior.

In view of the foregoing opinions, it seems obvious that there is need of some definite method for determining a machinability figure. It has been amply demonstrated that none of the methods for determining "hardness" gives any idea of machinability of malleable castings.

As by far the greatest part of the difficulty with high speed machining has been with the threading operations, we have endeavored to devise an apparatus to give a machinability figure, based on threading. We simply used an engine lathe, as indicated in Fig. 1. The pieces first tested were the standard 5/8-inch tensile strength bars, with one end sawed off. The remaining large end was held in the chuck. A standard die was held in a stock, and was forced on the 5/8-inch end of the test bar. To one end of the die stock was attached a rather accurate spring scale. When the chuck was revolved, a 5/8-inch thread was cut on the bar, and the pull required to cut this thread was of course registered on the scale. Giving the scale readings it is of course simple to calculate the actual pull on the die in cutting.

Samples were obtained to cover the range of 42,000 to 52,000 pounds tensile strength per square inch. Table I gives results of the first series.

A paper presented by Edwin K. Smith and William Barr at the annual convention of the American Foundrymen's association held in Philadelphia Sept. 29 to Oct. 3.

Table I

Results of First Machine Test

No.	Decarb. Depth	Tensile Strength	Elas. Limit	Elongation Per Cent	Lbs. Actual
8	0	40560	33333	7.0	791
1		47680	36220	7.0	813
N5.15-6	1/64	48000	35330	9 5	843
22		48295	34500	9.0	870
121		49195		12.0	952
N5.13-5	2/64	51870	37330	18.0	933
31425	4/64	46620	31380	7.5	979
U	3/64	50650	34950	11.5	1221
16		54320		10.0	1302

Table II

Second Machine Test

No.	Decarb Depth	Tensile Strength	Elas. Limit	Elongation Per Cent	Lbs. Actual
31418	3/64	41870	31000	7.0	625
3159	7/64	42810	31400	7.0	772
3164	5/64	40309	31710	6.0	808
31414	1/64	50120	35140	7.5	898
31526	2/64	43500	30870	7 0	[illegible]
31512		46870	31000	9.0	952
Gray Iron Bar		27370	27370	0.0	9,9
Cast Steel		51959	38210	10.0	1034
Gray Iron Plate					1077
31513	4/64	43720	32610	8.0	1104
3165	3/64	44210	33150	7 0	1137
Soft Steel					1493
Hard Steel					1676

Table III

Machine Test on Larger Bars

No.	Tensile Strength	Elastic Limit	Elong. Per Cent	Lbs Actual
Gray Iron	27370	27370	0.0	1220
-1°	45740	34140	7 5	1291
1-6°	42610	32000	9 5	1310
X2-3°	41110	36690	6 0	1310
N 5,15 6	48000	35330	9 5	1134
2 8°	42060	31030	9.0	1369
1X-4°	43750	36410	7.0	1428
3X-2°	44680	34520	7 5	1453
U	50650	34959	11.5	1495
C	46550	30260	11.5	1537
N-5.13-5	51870	37330	18.0	1537
Cast Steel	54950	38210	10.0	1596

Table IV

Results of Drilling Test

No.	Decarb. Depth	Tensile Strength	Elas. Limit	Elong. Per Cent	Time Min. and Sec	Inches Drilled	Inches Per Min.
Gray Iron Slab					3-2.0	.7559	.249
3-31425-	4/64	46620	31380	7.5	3-9.0	.7559	.240
4-31415-	3/64				3-9 1	.7559	.239
2xx-5-15-6N	1/64	48000	35330	9.5	3-11.0	.7489	.235
2-	7/64				3-16 3	.7559	.231
2x-3165-	3/64	44210	33150	7.0	3 26.5	.7911	.230
7-3149-	4/64				3-21.5	.7716	.230
4x-3159-	2/64	43500	30870	7.0	3-23.5	.7077	.226
5 3159-	7/64	42840	31400	7.0	3-26.0	.7755	.226
6 3151-	2/64				3-22.2	.7598	.225
1x-31513-	4/64	43720	32610	8.0	3-30 6	.7795	.222
5x-3164-	5/64				3-28.2	.7677	.221
3x 31515	4/64	45480	33580	7.5	3-28.2	.7637	.220
1xx-5-13-5 N	2/64	51870	37330	18.0	3-25 0	.7489	.219
8-31414	1/64	50120	35140	7.5	3-29.9	.7637	.218
5'x-8	0	40560			3-31 2	.7519	.214
1-31418	3/64	41870	31000	7.0	3 34 2	.7598	.213
4xx-C	3/64	46550	30260	11 5	3-36 0	.7519	.209
Gray Iron Bar		27370	27370	0.0	3-55 6	.7677	.196
3xx U	3/64	50650	34950	11.5	4-37 4	.8346	.181
Steel Soft					8-45 1	.7480	.085
Steel Cast		54950	38210	10 0	13-11.4	.7559	.055
Steel Hard					14 2.2	.7322	.052

The column in Tables I, II and IV marked "Decarb" gives the depth to which the carbon was burned out in the anneal. From these preliminary experiments, the authors were not able to find any relation between depth of decarbonized rim, and machinability.

The speed was 27 revolutions per minute; die, U. S. Standard ⅝-inch. These bars were all very nearly ⅝-inch diameter, and were very free from any irregularities of surface. The results are arranged according to the ease of machining, and it will be noted that generally speaking, the ease of machining decreases with increasing physical characteristics.

Thinking that possibly the small differences in diameter might affect results, we next selected a series of similar bars, and machined each to exactly ⅝-inch. These were threaded results being shown in Table II; speed 27 revolutions per minute; die U. S. Standard ⅝-inch.

In order to vary conditions, we next prepared castings with 1-inch diameter, and repeated the test, using a U. S. standard 1-inch die, speed 14 revolutions per minute. The surface of the castings was not machined before threading.

Drilling Tests

While these results, which are given in Table III, show very great variations, it is obvious that on the whole, ease of machining is sacrificed to higher physical characteristics.

It seemed possible that a drilling test might throw some light on the subject, so we fitted a vertical drill press, as shown in Fig. 2. A 50-pound weight was fastened on top of the spindle, the combined weight being 65 pounds. The spindle being thrown out of feed gear, we thus had a constant pressure on the drills, all of which were 15/64-inch in diameter. The speed was 206 revolutions per minute. The results are shown in Table IV. Time to drill through ¾-inch bar was determined by stop watch.

Although we have a wide variation in physical figures, we are unable to see any relation between these and speed of drilling.

One point which came up in this test, and which probably has some effect on difficulty in threading high tensile, high elongation iron, was that produced by the length of chip cut. The approximate length of chip made by cutting tool is given in the following table:

No.	Tensile Strength	Elongation Per Cent	Length of Chip, Inches
C	46550	11.5	⅜
5 15-6-N	48000	9 5	2
5.13-5-N	51870	18.0	5
U	50650	11.5	6

Obviously the longer the chip, the more trouble will be caused in threading, especially on the return operation, while with any ordinary cutting work, the long chip will do no harm.

While the results of all the foregoing tests are suggestive, it is obvious that in order to be in anyway conclusive, they must be repeated, under better conditions, and we believe that a very much faster feed would give better results. As our equipment is not suited for high speed on this work, we wrote the University of Wisconsin, and have recently received a letter, stating that the mechanical engineering department would be glad to run conclusive tests on this subject in the fall. They are especially well equipped for such work, and if it can be arranged, we should get conclusiv figures from their tests.

From the foregoing experiment and from all data available to u we can venture the followin opinions:

First—At medium speeds, all prop erly manufactured malleable casting can readily be machined, whethe such castings are of low or of moder ately high physical characteristics.

Second.—Where speed of machin ing is of greater importance tha great strength, a metal of say 42,00

pounds tensile strength, and 6 per cent elongation will give the best results.

To our minds, a very interesting point was brought up by results on machining bars of various kinds of steel and gray iron, as shown in tables II, III and IV. Of course too much cannot be judged from a test on a few samples, but from the figures shown we notice that the following results hold through the series of tests:

First.—The malleable bars machine approximately as easily as the gray iron.

Second.—The malleable has almost double the strength of gray iron and an elongation of about 8 per cent as compared to no elongation in the gray iron.

Third.—Malleable castings can easily be supplied to equal this grade of cast steel in all physical tests, and to surpass it so far as smooth surface is concerned. And at the same time the malleable castings will show a superior machinability according to the operation, ranging up to that shown in the drilling test where repeated tests on cast steel showed that it required about four times as long to machine cast steel as malleable of similar physical properties and characteristics as nearly as a comparison might be drawn.

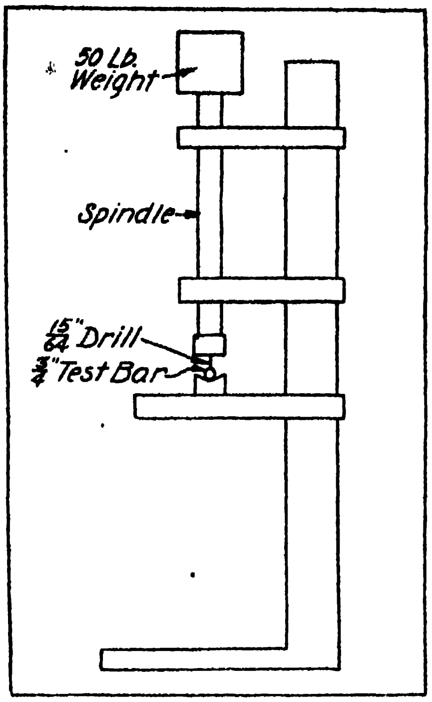

FIG 2—APPARATUS FOR DRILLING TEST

Hard Spots in Castings

By H. E. Diller

Question:—Small castings, under a pound in weight, which we make, frequently have hard, white spots around the edges. The analysis of our iron averages: Silicon, 3.22 per cent; sulphur, 0.050 per cent; phosphorus, 0.74 per cent; manganese, 0.87 per cent. We would like to know the cause.

Answer:—The hard, white spots at the edges of your castings were probably caused by wet sand which chilled the metal at the places which were white. In a similar case it was found that the molder was swabbing the corners of the molds with water to prevent the edges from breaking.

High silicon irons such as you are melting are particularly subject to chilling under these circumstances. We would recommend that you run the silicon in your metal between 2.25 and 2.50 per cent and guard against moisture

Elimination of Strains in Castings

BY C. J. WILTSHIRE

IT IS a well known fact that appreciable strains which are caused by unequal radiation of heat from the castings after they are poured remain in iron castings after cooling. This unequal radiation is due to variation of section and difference in length of paths through which the heat must pass to escape from inner to outer surfaces. In consequence the heat is not uniformly dissipated. The portions where the metal is thickest and also those most remote from the point of heat exit, retain their temperature longest, and as result, shrinkage strains are set up in the parts which cooled first.

Some 22 years ago, Alexander Outerbridge, of Philadelphia, discovered that vibration of a cast iron bar (by tumbling in a barrel or by a continued tapping with a hammer) would invariably increase the strength of the casting. The theory of this treatment is that the action of cooling causes molecules of iron to be held in tension which is relieved when the casting is subjected to vibration.

It has since been found that this tension can be relieved by annealing the castings in an oven of moderate temperature. It is the purpose of this paper to describe the method.

That shrinkage strains exist in most castings is demonstrated by the fact that if a plain cast-iron plate be machined to a true surface on one side, the operation of machining the other side will frequently disturb the accuracy of the surface first finished. This phase of the matter was presented to the American Foundrymen's association in a paper on "The Seasoning of Gray-Iron Castings," by L. M. Sherwin, of Brown & Sharpe Mfg. Co., at the Boston meeting in 1917, and later published in the October, 1917 issue of THE FOUNDRY.

Large castings which have been left in the sand to cool off slowly and then finished to true dimension, have been found distorted under ordinary temperature changes, after a few days, but these same castings after treatment in the oven did not show any change whatever.

Other castings which have been finished and put under steam for test have shown considerable distortion when taken apart, while castings from same patterns when treated in an oven before finishing and tested out in the same way, showed no change.

Again, large castings which have been finished and lined up as parts of a large unit, have shown sufficient distortion to cause parts of the machine to become out of line after a number of months in service. Such castings are now being annealed and from results obtained it is believed that this treatment will prevent the defects experienced.

The method of treatment is as follows:

The castings are placed in the oven, the doors are closed, the heat turned on, and the temperature raised to 700 degrees Fahr., which generally takes from seven to eight hours. This temperature is held for an additional seven hours, when the heat is shut off and oven is allowed to cool down slowly for approximately 20 hours, with a resulting temperature of about 300 degrees Fahr. The oven doors are then opened and temperature is allowed to drop to approximately 150 degrees Fahr., when the castings are in shape to be taken out. The entire operation consumes about 48 hours.

The ovens are heated with oil and the amount of oil per ton of castings treated has averaged 9.6 gallons. Each heat required 284 gallons of oil and approximately 29 tons of castings were treated each heat.

A paper presented at the Philadelphia meeting of the American Foundrymen's association, Sept. 29-Oct. 3. The author, C. J. Wiltshire, is foundry superintendent, General Electric Co., Schenectady, N. Y.

Sulphur Reduced in Malleable Iron

Cupola Metal Refined in the Electric Furnace—Sulphur is Lowered by a Reducing Slag Containing Calcium Carbide—Advantages of Such a Duplexing Process are Considered

BY A. W. MERRICK

THE American or blackheart malleable cast iron produced in this country is usually melted in air (or reverberatory) open-hearth or cupola furnaces. Either of these types of furnaces offer certain inherent advantages and disadvantages, but as it is with the last named that we are to deal in this paper, the discussion will be limited to this one method of melting.

Its advantages are briefly as follows: Low initial investment; low cost of operation, upkeep and repairs; intermittent or continuous operation which gives a great flexibility of capacity; high melting ratio of iron to fuel, and ability to melt high percentages of cast iron and steel scrap without the consequent lowering of the carbon content which would necessarily follow in either of the other two types of furnaces. From the foregoing it will be seen that the cupola will produce molten cast-iron at the spout cheaper than any other type of furnace, and this fact is universally conceded by all authorities.

There are, however, certain disadvantages in cupola melting as applied to cast iron in general and malleable cast iron in particular. First, the sulphur absorbed from fuel is higher with this process than either of the others. Secondly, it is not possible to produce an iron of a low carbon content, which with malleable iron limits one to the production of casting of very light section. This is due to the fact that the melting stock, being in intimate contact with the incandescent carbon of the fuel, absorbs carbon so readily, that with the constant silicon aimed for in malleable iron, a practically saturated condition is reached so that with other conditions equal, the carbon is never very far either above or below a fixed point. This holds good even where the percentage of steel in the charge is varied considerably. Thirdly, cupola iron, especially on long heats, is liable to quite a variation in temperature and composition. The latter evil is especially aggravating in malleable work where the importance of keeping the two elements sulphur and manganese, in a proper relationship is well recognized.

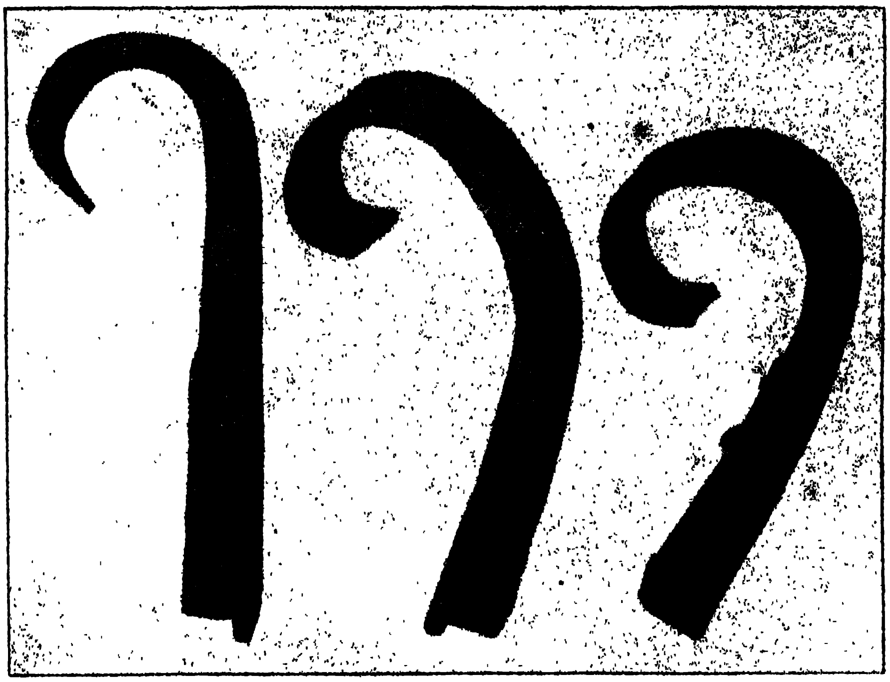

FIG. 1—RESULTS OBTAINED WITH TEST WEDGES OF LOW MANGANESE IRON

In order to overcome these last two disadvantages we might utilize some sort of a mixer that would act as a reservoir and by holding a given quantity of metal allow it to become constant in temperature and composition. The difficulty with this plan, is of course, that the temperature of the molten metal would be constantly lowering unless some external source of heat were applied, so that the question narrows itself down to just what this source of heat would be. The electric furnace, at once suggests itself as ideal, for in addition to supplying the heat needed, it will also allow the removal of the greater part of the sulphur by use of a proper slag. Not only this, but it will, in addition, allow an iron of any carbon content to be made by the means of additions of either cold or liquid steel, so that compositions of any range of carbon and silicon can be made and any castings of sections practicable in malleable iron may be poured. The advantages of such a duplex process are readily apparent to anyone familiar with the production of cupola malleable iron. Cupola iron is especially suitable for castings of light section such as pipe fittings, etc. In the latter case where an iron high in carbon is desirable, because of the greater ease of threading the fittings this process should recommend itself immediately. In addition to the advantages previously enumerated it would permit the annealing of the white iron at a considerably lower temperature than is practicable with a high sulphur iron, such as is ordinarily produced in the cupola.

In order to determine how far it is possible to reduce the sulphur in cupola iron in a reasonable length of time by this process, some sprues and scrap were obtained from a manufacturer of cupola malleable iron and melted in a small Heroult electric furnace. The material had the following composition: Silicon, 0.65 per cent; manganese, 0.53 per cent; phosphorus 0.143 per cent; sulphur, 0.20 per cent and carbon, 3.06 per cent. This analysis was supplied by the firm which furnished the scrap and was given as the average. No attempt

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Paper presented by A. W. Merrick at the annual convention of the American Foundrymen's association held in Philadelphia, Sept. 29-Oct. 3.

The author is metallurgical engineer in the research laboratory of the General Electric Co., Schenectady, N. Y.

was made to check it due to the difficulty of securing an average sample of material of this nature.

The scrap was melted bare in the furnace and then a basic slag of lime thinned with spar was put on. Finely ground petroleum coke was sprinkled over the slag to reduce all oxides throwing the metals back into the bath. the slag turning a creamy white color, indicating the completeness of these reactions. Calcium carbide is formed in the slag as is evidenced by the pronounced odor of acetylene when such a slag is moistened in water. A slag of this character will readily absorb sulphur from the bath and while the reactions require some time for completion, the practical elimination of the sulphur is very rapid.

Accordingly, 15 minutes after the slag was made a sample was taken for analysis, with the following results: Silicon, 0.57 per cent; manganese, 0.54 per cent; sulphur, 0.057 per cent; and carbon, 3.36 per cent. Note the reduction of sulphur which is very striking when it is considered that the sample was taken just 15 minutes after the formation of the slag. There is something further of note, namely the retention of the manganese. This element is readily oxidized in the cupola and it is customary to run the mixtures very high in manganese to take care of what is burnt out in melting and still leave enough for the high sulphur that is obtained. With the electric furnace, no speigeleisen, ferromanganese, or high manganese pig is necessary, and in fact, as will be later shown, the mixtures, to get best results, would have to be kept low in this element. As was mentioned before, the analysis before melting was supposed to represent the average so that the slight difference of silicon obtained need not be considered. The carbon, however, seems to have increased, but there is a possibility of doubt here, as 3.06 per cent seems rather low for cupola iron in the first place. Then again, when carrying a refining slag on low carbon steel, which is greedy for carbon, the increase due to additions of coke to the slag are so small as to be negligible.

FIG. 2 STRUCTURE OF CENTER OF TEST BAR

At the same time the sample was poured for analysis, a set of test bars was poured and after cooling the bars were broken and fractures examined. The bar ⅝-inch in diameter was clear white and the 1¼-inch bar nicely mottled so that the composition seemed all right for the class of material under consideration. A set of test bars and wedges for annealing was then poured.

In order to obtain iron more suitable for work of a heavier section, some steel and ferrosilicon in calculated amounts were added to the bath. The calculation was based on the 3.08 per cent of carbon as supposed to have been in the original material but as it was actually higher in carbon the result was higher than desired. However, it was near enough for the purpose, to illustrate the possibility of producing an iron of a lower carbon than is ordinarily obtained in the cupola. The actual analysis is given as follows: Silicon, 0.75 per cent; manganese, 0.53 per cent; sulphur, 0.036 per cent; and carbon, 2.90 per cent.

Slag Lowers Sulphur

It is interesting to note in passing that the analysis obtained was exactly that expected, taking into consideration the actual first analysis, and the analysis and amounts of the additions. Anyone who has had experience in adding ferrosilicon to an air furnace where a strongly oxidizing condition prevails, to bring up the silicon, can appreciate this. The sulphur is still lower in this sample, which can be attributed to the further refining of the slag, for even had the steel contained no sulphur the resultant would have only been 0.045 per cent, had the slag not absorbed more from the bath.

Test bars of this composition were poured and both sets of bars were subsequently sent to the firm that supplied the scrap for annealing. They were packed in the second pot from the bottom and placed in about the middle of the oven.

The examination of the bars after annealing showed that the metal was inclined to be rather "short" and that it lacked toughness. This might easily be expected when the high manganese, low sulphur composition is taken into consideration. The fractures viewed with the eye looked like typical blackheart iron with the exception that the rim of ferrite is heavier than usual. Under the microscope, however, we find that the structure consists of a rim of ferrite and the interior a matrix of ferrite and pearlite embedded with temper carbon, instead of a pure ferrite matrix, characteristic of good blackheart iron.

As it was impossible to obtain any low manganese, high sulphur cupola iron without making it especially for our purpose, a mixture of gray scrap, washed metal and steel was melted to give a composition approximately that obtained by refining a cupola iron high in sulphur but low in manganese. Bars were cast from this heat as previously and annealed. The composition was similar to the first lot prepared except that the manganese was 0.14 per cent and the sulphur 0.009 per cent. In this case where the sulphur was low to start with, it had practically been eliminated by the action of the slag in the furnace.

These bars after annealing were quite a lot better than those first prepared, containing manganese over 0.50 per cent. The test wedges could be curled up more, as is shown in Fig. 1. The tensile strength of this composition is from 38,000 to 40,000 pounds, but the elongation in 2 inches is only 3.5 per cent. The molding was bad and these were very defective looking bars. The bars when polished and etched, showed an improved structure over the first set but still showed some pearlite in the rim, although the center of the bar showed the typical blackheart structure. This is shown in the photo micrographs, Figs. 2 and 3.

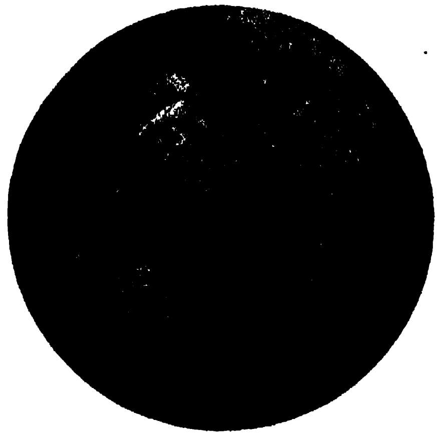

FIG. 3 STRUCTURE OF RIM OF TEST BAR

The conclusion to be drawn from this result is that evidently there is still too great an excess of manganese present for the low sulphur and some further work is planned to verify this.

Among the conclusions which the author arrived at are the following:

1—The cupola is the cheapest method for producing molten cast iron,

but the process has several inherent disadvantages that have limited the use of cupola malleable to work of light sections. It produces iron high in sulphur, and variable temperature and composition.

2—The electric furnace is capable of refining this iron, reducing the sulphur to a negligible amount and superheating the metal to any desired degree without any further altering of composition.

3—Such a process as described will permit iron of any carbon and silicon desired to be made by the proper additions of steel and ferrosilicon.

4—Where this duplex process is used, the amount of scrap used in the cupola can be increased and the fuel decreased as it would not be necessary to have the iron as hot as is the practice when poured direct into the molds.

5—The mixtures would have to be kept low in manganese, no high manganese pig or spiegeleisen would be used and it is believed that by using low manganese scrap that the amount of manganese burned out in the cupola would lower this element to the point desired. This will have to be worked out definitely in the future from further experimental data.

6—As to costs, no figures can be given as the process is not believed to be in operation as specifically outlined in this paper. However, the power required ought not be more than 150 to 200 kilowatt hours per ton on molten metal from the cupola and with continuous operation, the labor charges should not be excessive. These costs would be offset by the lower cost of melting stock, reduced amount of coke used in melting and the lower temperature of the annealing ovens for the annealing of such low sulphur iron.

Electric Furnace an Adjunct to Cupola

THE advantages of a duplex process using the electric furnace as an adjunct to the cupola for melting gray iron were outlined by George K. Elliott in a paper presented at the annual convention of the American Foundrymen's association held in Philadelphia, Sept. 29-Oct. 3. The author called attention to the fact that while the cupola is an efficient furnace for melting iron it has certain limitations which prevent it from furnishing an iron which entirely meets the requirements for certain classes of castings. But for the ordinary run of iron castings, comprising possibly 90 per cent of the total output of the country there was said to be no valid economical reason for either displacing or radically modifying the modern cupola.

The author goes on to say that whatever its faults may be, it must be acknowledged that for preheating iron up to the point of melting, and after that performing the fusion itself with a minimum waste of heat, the cupola stands supreme among the established foundry furnaces. Its melting efficiency approximately is 40 per cent although in the hands of the unskilled it may fall as low as 25 per cent, while the adept may drive it along at a rate of as high as 50 per cent efficiency. Although the cupola is practically without rival as a preheater and melter it does not attain the same high rank as a superheater of molten metal. The cupola operator's problem in obtaining superheated iron is largely one of circumventing terrestrial gravitation as it is manifested in the speedy dripping of the molten iron through and away from the hottest zone of the cupola.

In the two-step process that has been described, all responsibility for superheating is taken from the cupola and assigned to the electric furnace, where with the greatest ease it can be superheated to a degree that is not possible in any other kind of furnace. Superheating in the electric furnace enables the foundryman to make castings of low-phosphorus iron which otherwise it would be necessary to make of high-phosphorus iron, because he can safely shift the responsibility for fluidity from the material to the furnace.

Another advantage, and by no means a minor one, is that hot iron tends to increase solidity in castings. By solidity is meant not only closeness of grain but freedom from internal imperfections such as blowholes, shrink-holes, slag inclusions, graphite segregations, and similar defects.

Refining Agents

The process of treating iron in the cupola cannot be extended beyond the point of melting and a certain limited amount of superheating. Any additional operation such as refining, is entirely out of the question and can be performed only in some other kind of furnace. In considering the electric furnace in relation to refining it is preferable to consider separately the acid-lined and the basic-lined furnaces. The acid-lined furnace refines entirely through maintaining a constant reducing atmosphere in contact with the metal. The refining in an acid furnace is one of deoxidation coupled with a freeing of the bath from included gases and slag.

One must turn to the basic-bottom electric furnace to find potentiality in refining at its greatest. Almost any metallurgical reaction may be conducted in it, including oxidation, reduction, dephosphorization, desulphurization, decarburization, carburization, mixing with ferroalloys, superheating, and others. The duplex process for cast iron is chiefly concerned with reduction, desulphurization and mixing.

Standard pig iron containing a maximum of 0.05 per cent, sulphur contains from 0.07 to 0.11 per cent after coming from the cupola, the degree of contamination depending upon the quality of coke, the condition of the cupola and its accessories, and the skill and knowledge of the cupola tender. The same iron from the cupola may subsequently have its sulphur reduced to about one-third or one-fourth by 30 or 40 minutes refining in a basic bottom electric furnace. The average of a great number of *duplexed* heats of gray iron was .088 per cent sulphur in the melt from the cupola, while in the final product from the electric furnace the average was 0.030 per cent. As low as 0.009 per cent sulphur in occasional heats has been produced in gray iron under everyday working conditions.

The electric furnace step of the duplex process is particularly good for mixing. It enables a perfect mixing of the original raw materials, assuring homogeneity in the single heat, and it facilitates the accurate duplication of results, assuring uniformity among several heats. It also simplifies and insures the perfect admixing of alloys such as ferrosilicon and ferromanganese. The electric furnace allows steel scrap to be mixed with the iron and by this means the amount of total carbon in the metal can be controlled, while when steel scrap is mixed with iron in the cupola an indefinite amount of carbon is taken up from the coke.

Educational Value of a Scrap Pile

Defective Castings Are Not Altogether Without Value if They Suggest to the Foundryman's Mind a Method for Prevention of Trouble in the Future—Where Study is Needed

BY HENRY TRAPHAGEN

DEFECTIVE castings—the tenants of the scrap pile—offer to the discerning and ambitious foundryman knowledge that is beyond price. Show the foundry expert the scrap pile, and he will tell you the caliber of the foundry, for evidence of either constructive progress or the senseless repetition of blind ignorance, is indelibly and relentlessly stamped on that tell-tale pile of rusting iron.

It all depends upon whether the defective castings are intelligently examined or are buried away under old barrels, what the real value of the scrap pile will be to the foundry. Intelligently examined and constructively criticized, a defective casting will invariably point out the antidote; but if it is hidden away and treated as an enemy it means that casting after casting will be turned out in the same old way; the customer will be dissatisfied; the foundryman will make no progress; and the establishment itself will finally rest in the financial scrap heap.

The up-to date foundry should have at least one competent, experimental molder, paid by the day, and not hurried; his business would be to investigate the proper method of gating and heading castings as they come into the shop. Every department should be interested, every responsible department head should lend his bit to the fund of general knowledge. The work of the experimental molder should be thoroughly examined, and discussed. If consistent and concentrated effort is made, it will be but a short time before the experimental molder turns out a sound casting.

He May Go to China

When the casting comes right it should be either sketched or photographed with the gates and heads attached, and a permanent record made. If the same job comes back a year or two later it is immaterial whether the experimental molder is in China or the superintendent in parts unknown—that casting can be made again, for the proper method of making it is on record.

It would appear at first sight that experimental molding would be an almost endless task; that the experimental molder would have to start out on an entirely new tack every time a casting came into the shop, and that the number of records necessary would be almost overwhelming, but if foundrymen will carefully investigate this method of experimental work, they will find that after all, the number of real basic defects that are found in castings are comparatively few. They will discover that castings naturally group themselves into a few well defined classes, and that each class is subject to characteristic defects that are easily recognized, and in a short time they will learn to discount possible defects at the start.

Scrap Tells the Tale

THE size and composition of the domestic scrap pile in the foundry yard is a fair indication of the success or failure of the methods in vogue for producing castings. One way to reduce casting losses is to have all new work pass through the hands of a highly competent molder. He should be allowed to experiment until he has arrived at the one best way of making each piece. With a satisfactory method once established, a photographic record should be made showing all the important details. Having this record it would be perfectly immaterial whether the personnel of the foundry changed or not. The records would always be available for whoever needed them.

While it is true that the great majority of castings are lost through some fault in the molding practice, it is equally true that a sufficient number are lost through metallurgical faults to warrant the utmost vigilance on the part of the foundryman, both in buying his iron, and later, in melting it.

Some iron is fundamentally bad and will never produce satisfactory castings. An off heat of pig iron, due to one of a variety of causes which interrupt the even working of a blast furnace, is in this class. So is thin, rusty sheet scrap. Rust is oxide of iron and during the melting process it enters the metal and becomes emulsified. No amount of flux, deoxidizer or cleansing agent will get it out. Suspended oxide is responsible for the rejection of many castings, more especially those which have to undergo pressure tests.

If the foundryman can grasp the broad conception of castings as a whole; if he can master the few fundamental laws of solidifying metal, he will have made no small measure of progress toward the desired end. But unfortunately, it seems to be the common impression that the various branches of iron and steel founding are each peculiar to themselves; for instance, the malleable man imagines that his troubles are quite distinct from those found in the gray iron shop; while the gray iron founder is under the impression that gray iron and semisteel obey laws that were designed especially for them; and it is sometimes amusing to hear the steel man dilate upon the peculiar and mysterious troubles of the steel business

Literature Deficient

Now if the foundryman will only recognize the fact that all these various metals are alloys of carbon and iron; that they all merge into each other without any sharp line of distinction; and furthermore, that they all in general obey the same laws, then, a great light will dawn upon him and he will realize that there are but few real basic troubles in a foundry.

Several fundamental difficulties that are found in foundries have been described in the literature on the subject; but unfortunately these descriptions seem to be lost in a maze of words dealing with the various peculiarities of chemical ingredients, new fangled methods of chemical analysis, long discussions on grain aggregates, and in fact, everything under the sun, except a frank, plain discussion of the foundryman's troubles. It is because of the great difficulties in wading through a mass of literature that the average foundryman has become disgusted with chemists and scientists in general; and judging from the impractical, high-brow contributions that they have given later-day literature, it

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From a paper presented at the twenty-fourth annual convention of the American Foundrymen's association held at Philadelphia. The author, Henry Traphagen, is metallurgist for the Toledo Steel Casting Co., Toledo, O

would appear that the foundryman's disgust is well founded.

If the foundryman will carefully study his defective castings the writer believes that he will ultimately agree that all of the defectives can be traced to one of a very few fundamental errors. In general, these fundamental errors may be summed up as follows:

First.—The personal equation, or in other words, the carelessness of the workman.

Second.—Over-production, which puts a premium on careless, sloppy work.

Third.—The attempt to make good material out of junk.

Fourth.—False economy, which results from the use of too little fuel, too much scrap, cheap refractories and too great a reliance in green sand molding practice.

It has been the writer's experience that about 10 per cent of all troubles in the foundry can be traced to the melting department and the other 90 per cent to the molding department.

To produce a good casting from any kind of iron or steel, it is absolutely essential that the metal be hot and fluid. But unfortunately, hot, lively metal is not as common in our foundries as one would be led to expect, and the causes of cold metal may be briefly summarized as follows: The bed in the cupola may be too low. This is a very common error and generally results in cold, sluggish metal. It is a simple matter to determine whether or not the bed is low. Leave the tap hole open, turn on the blast, and note the time that it takes for the first metal to run over the spout. If iron appears in less than 10 minutes, it is almost a certainty that the bed is too low. A low bed means dirty, porous, weak castings, owing to the metal melting directly in front of the tuyere blast and becoming unduly oxidized.

Correct Melting Ratio

Another prolific source of cold metal lies in the attempt to conform to a prearranged melting ratio. In the dictionary of common sense there is no such term as melting ratio. The correct melting ratio is the amount of coke that will give hot, fluid metal; and this amount of coke will vary with the size of the cupola, the amount of scrap used, the kind of coke, the percentage of steel used in the mixtures, and the size and condition of the sprues. It is therefore evident that it is ridiculous for anyone to attempt to lay down a specific melting ratio for cupola practice.

Cold metal in the converter can generally be laid to one or two causes. The metal from the cupola may be cold for one of the reasons just enumerated; the percentage of silicon may be too low for successful blowing, or what is most common, the lining of the converter may be too wet, or there may be a leak in the wind chest or somewhere along the line. It is rarely found that cold metal can be traced to a variation in chemical content, and before the foundryman wastes any time fooling around the laboratory, it is far better for him to examine his cupola practice, his converter linings and his wind apparatus.

Another Cause for Cold Metal

There is another great fundamental cause for cold iron, it is found not only in the cupola, but in the converter, the air furnace, the open-hearth furnace, the crucible furnace and even in the electric furnace.

Reference is made to the effects of oxygen, which causes oxidized metal. There is no disputing the fact that foundries very frequently receive shipments of pig iron that will not produce hot iron, no matter how careful the melting practice may be, and such iron is delivered much more frequently than the average foundryman is aware of. It is useless to check up the analyses of such material, for the blast furnace laboratory report will in nearly every case be correct, and the fact that it is correct furnishes the chief alibi for the furnace.

Pig iron is sold on chemical analysis only, and it is presumed that if the analysis conforms to the customer's requirements the iron must necessarily be satisfactory, but nothing, in my judgment, is further from the truth. The pig iron that generally causes such a long train of disagreeable troubles, such as porous castings, skulled ladles, bunged-up cupolas, etc., is a product of over-production.

If, on breaking a shipment of iron it is found to be consistently unsound and full of gas cavities, reject that iron if it is possible to do so. But if the furnace absolutely refuses to take such iron back, which is too often the case, then the only course left to the foundryman is to hold the shipment in the yard and use it very gradually, say one pig to a charge, until the pile is gone.

The writer has found defective pig iron in practically every kind of a foundry including malleable iron, gray iron and steel plants.

Another source of cold, sluggish iron and steel lies in the use of thin, dirty, rusty scrap. Such material as rusty flashings, turnings, shearings, punchings and other fine voluminous scrap should have no place in the melting furnace, if the melter expects to get sound, healthy metal. Such scrap is being used literally by thousands of tons in our open-hearth furnaces today. It is common in steel foundries, malleable shops and gray iron foundries. But the result is the same, no matter what type of furnace is being used or what kind of product is being manufactured.

Rust is an oxide of iron, and it is finely divided. During the melting process this rust or oxide enters the metal and becomes emulsified. And no amount of fluxes, deoxidizers, or other cleansing agents will get it out. I believe suspended oxides in metal are causing more trouble today in the iron and steel industry than any other one thing. The use of such material is directly at variance with all the sound principles of metallurgy. How long the manufacturers will use this material and how long the consumer will continue to receive such metal is a problem. But the light is breaking and the day of reckoning for the iron and steel manufacturers who attempt to melt up nothing but junk, is close at hand

Cold metal is distinctly a problem for the melting department, but it effects the molding department so strongly that the molder must take it into consideration. It is a well known fact that the moment molten metal strikes the sand a large volume of gas is generated. This gas is formed from the decomposition of binding materials, but most of it comes from the water that is in the sand.

If such gas is not allowed free exit, it is going to be trapped in the metal; the colder the metal is the more quickly it will set, and the more likely it is that the gas will be trapped under a frozen skin.

How many times does a foundry turn out what is apparently a perfect casting only to have it rejected in the machine shop just as soon as the first cut is taken from the cope side. The gas trying to escape has been trapped just below the surface because the metal has set too quickly to allow the gas to get away; this is a very common defect in green-sand molding: hence the necessity when attempting to make green-sand work, of having the metal very hot and fluid and venting not only the cope but the drag, and making sure that the vents in the cores are wide open

The Sins of the Cover Core

An interesting sidelight in connection with this discussion is the question of using oil-sand cover cores. It is a very common occurrence to find a casting made under a thick, hard oil sand cover core, with absolutely no provision for the escape of gas. The foundryman struggles along and probably gets two out of 10 castings whereas if he would merely puncture

the cover core with three or four pop heads and let the gas out, the probabilities are that all of the castings would come good.

The question of shrink heads or risers is one that is given too little consideration in the foundry. A head to be of any value, must be large enough in cross section to remain open until the casting has set. It is well to remember that probably not over 30 per cent of the cross section of a head is available for feeding and this statement applies with more than ordinary force to the neck of the feeder; it is folly to make a great big head and then neck it down so narrow that the neck freezes almost instantly, and it is equally futile to expect a head to feed if it is not placed squarely upon the casting. How often does one find a head with a neck say 2½ or 3 inches in diameter about one-fourth of which is attached to the casting and the rest wandering off in space.

The common practice of taking an old splintered block of wood, sticking it to the pattern with a nail, and attempting to make an efficient head is the falsest of false economy. A foundry should have a stock of standard heads carefully made in the pattern shop and fitted with dowel pins so that they can be set squarely upon the pattern with little danger of being misplaced.

Welders Work Overtime

There is a tendency among foundrymen of the present day to skimp on heads. They love to talk about their very low sprue returns but they neglect to state that the welder works overtime every night. Molten metal will shrink as it cools and that shrinkage must be taken up either by overhead feeding or internal chilling, and when a foundryman tries to tell you that his castings are sound without any kind of feeding, that man is trying to change the laws of nature, and personally I cannot see how he expects to get away with it.

Another important point is the part that water plays in the foundry. There is probably no other one factor with the possible exception of oxygen, that has so much to do with the success or failure of a foundry. Consider for a moment some of the troubles directly traceable to the old H_2O. In the cupola for instance, we have the well known rubber bottom arising from wet bottom sand; we have cold metal and slow melting from wet coke, wet iron, and moisture-laden air. In the converter we have wild heats, cold metal and cut linings. We find pin holes in the castings due to the metal boiling on the surface of a wet mold; we have entrapped gas and dirt, because too much water in the facing and heap sand has frozen the metal prematurely.

A casting may look sound, but millions of tiny bubbles of exploding steam have made it porous so that it will not stand up under gas or water pressure. All over the country foundries are making hydraulic and ammonia castings by the green-sand method; and they are stoutly claiming the fact that they are getting away with it. Careful investigation, however, will prove that the consumer is kept busy closing up porosities and every so often a truck load of defective castings is brought back to the foundry and is carefully smuggled in the back door, so too many people won't see them. It is possible to make hydraulic castings in green sand molds, but it is not possible to make them day in and day out and be fairly certain that they are all sound. It is almost an impossibility to control the water in the green sand mold; and water suddenly converted into steam has a habit of exploding in the most unforeseen places and in the most peculiar ways. As a general rule, a hydraulic or gas casting should be made in a thoroughly baked mold, and if proper materials are used, and the melting is carefully done and the mold is kept clean, there is no trick in turning out acceptable hydraulic castings.

There is one more item in the molding department that deserves attention and that is the proper method of pouring. The scrap pile receives a great many contributions because of the carelessness or incompetency of the man at the ladle. Every ladle of metal should be held for a minute or two to allow the slag and other impurities to come to the surface. Stopping to allow the metal to clear itself may seem like a waste of time to the modern production hog, but if the gentleman will stand by a ladle and watch the various impurities float up to the surface he will understand why it pays to give the metal time to clear. In the end more good castings will accrue from such practice, and in the final analysis real production will be increased. Metal going into a sand mold should be poured evenly and carefully and under no consideration should hot metal be poured at high pressure directly over a large flat area of sand. Cuts and scabs and snakes are too often the result of fast, furious pouring. It is far better when dealing with a casting having a large flat surface, to cut back-up gates and break the force of the stream of metal rather than resort to a mass of finishing nails, a lot of swabbing and other dodges to prevent the facing from cutting.

Another exceedingly common error is the practice of pouring metal at right angles directly up against a core. If it is possible to allow the metal to slide parallel to the core, there will be far less cutting and much less dirt.

It is obviously impossible for any one man or group of men to enumerate, much less describe, the many apparent defects and troubles that exist in a foundry. If the foundryman will carefully study and examine the defective castings, if he will try to trace out his problems from cause to effect rather than trust to dumb luck, he will find, as stated before, that the real fundamental troubles in the foundry are comparatively few.

The value of a scrap pile lies in the fact that it offers a real course of instruction in foundry practice, and this paper has been written in an attempt to induce the foundryman to commune with his defectives, to study their peculiarities, to grasp the principles of casting in their broadest sense, to realize his responsibility to the community, and finally, it is written with the hope that the foundryman will earnestly strive to manufacture sound castings, rather than alibis and fictitious production sheets.

Show Precipitation Model

A model illustrating the operation of the Cottrell precipitation process for removing flue dust from blast furnace gases was exhibited at the Chemical Exposition in the Coliseum, Chicago, Sept. 22 to 27. This model was made by the General Electric Co., Schenectady, and was shown under personal supervision of Chester T. McLoughlin assisted by Raymond Barclay, both of the General Electric organization.

Training Workers

Training bulletin No. 24, entitled "Industrial Training for Foundry Workers" has been published by the United States department of labor, United States training service, and will be forwarded to any person interested by applying to C. T. Clayton, director, Washington. This report was issued in preliminary form some time ago and published in the July 15 issue of THE FOUNDRY.

The Worthington Pump & Machinery Corp. has taken over the Epping-Carpenter Pump Co., Pittsburgh, the plant of which will be known as the Epping-Carpenter works of the Worthington Pump & Machinery Corp.

Plea for Less Rigid Sulphur Limits

Usual Requirements Regarding Sulphur in Specifications for Cast Steel are Considered too Exacting—Molding, Steelmaking and Annealing Practices are Said to Affect the Casting More Than Somewhat Higher Sulphur Content

BY A. E. WHITE

IT is not the object of this paper to add any new evidence to that which already has been presented. There has been no opportunity, since the writer was requested to prepare a paper on this subject, to make experiments and tests. It is the object of the paper to plead for a thorough survey of the items which affect the quality of steel castings and to judge of their acceptability on the basis of the properties they possess rather than to lay undue emphasis on one or more disputed points.

Considerable has been written concerning the effect of sulphur in steel. Numerous writers have pointed out that sulphur in percentages much above 0.04 or 0.05 gives material showing undesirable qualities. Now and then some one suggests that sulphur in percentages greater than 0.04 or 0.05, possibly as high as twice the values given, in no way affects the quality of the steel. Much that has been written is in the way of exposition and is not supported with evidence. Furthermore, a considerable amount of the evidence submitted is so beclouded by other factors that the data is valueless. Practically all of the literature discussing sulphur deals with its influence in rolled or forged steel and not in cast steel. Between cast steel on the one hand and rolled or forged steel on the other, there is, in the writer's opinion, a vast deal of difference. Therefore the observations on the influence of sulphur in rolled or forged steel, relatively speaking, may have little bearing if applied to cast steel. This, briefly stated, is the status of the question at the present time.

Factors Affecting Quality

Broadly speaking, there are five main factors which affect the quality of steel castings. These are design of castings, composition, molding practice, steelmaking practice and annealing practice.

Included in the molding practice may be listed the kind of mold, whether of green or dry sand; method of venting; weight and location of riser; method of gating; character of cores; length of time mold is kept around metal after pouring, etc.

In the steelmaking practice may be included place of recarbonization, whether in furnace, converter or ladle; size of heat; number of castings to be poured from a given ladle; temperature of pouring, etc.

In the annealing practice may be included the evenness of furnace temperature; the temperature employed; the time consumed in bringing to heat; the time at heat; the time consumed in cooling; the type of castings placed in a given furnace, whether all light, all heavy, or mixed; the type of furnace used, whether a furnace designed for heavy castings employed on light ones or vice versa; character of flame, whether oxidizing, reducing or neutral; etc.

There are times when too little attention is given to the question of design of steel castings. Many designs are made by men who know too little about the characteristics of metal when it is changing from a liquid to a solid. Much improvement in the matter of quality of finished castings could be brought about by closer co-operation between the designer and foundryman, and it is trusted that as time goes on, this suggested closer co-operation will become more and more common.

Purchaser's Inspection

In general, the steelmaking and molding practice is of an acceptable character. In large measure, however, the purchaser is in the hands of the founder since it is not feasible for him to employ as expert a steelmaker or steel founder as the steel-casting operator can afford to do, and only by the employment of an abler steelmaker or founder can he expect to properly pass upon these phases of the process. Even if he can get a man of suitable experience, it is questionable if he should employ him, for by so doing, a status of divided authority in the steel castings plant would develop, and such a condition would be most unsatisfactory and in fact, quite impossible. Also, by chemical, physical and visual tests the purchaser can gather sufficient information regarding the character of the castings to decide whether or not they are acceptable, so that he is not as much at the mercy of the founder as might appear to be the case at first glance.

The writer believes much greater attention should be given to the matter of annealing, in the future, than has been accorded it in the past. As a rule, steel founders have not awakened to the latent possibilities of scientifically controlled annealing. Many furnaces bear indications that the only things thought of in their design are walls, a floor, a roof, and some kind of ports for the admission of heat.

Irregularity in Annealing

There seems to be an utter disregard of such questions as fuel efficiency, through proper combustion and control of heat losses by radiation and by the stack; character of the flame, whether oxidizing, reducing or neutral; scientific temperature control, for in most furnaces there is as much as 200 degrees Fahr. difference in temperature in different portions of the same furnace; accurate temperature measurements, for such furnaces as have pyrometers usually have only one and it is neither frequently calibrated nor does it necessarily record the real conditions in the furnace because of the varying temperature distribution in the same; and care in the selection of only pieces of approximately the same cross section for each furnace per anneal, for there exists a more or less haphazard method of placing castings with different cross sections in the same furnace with the resultant of either overheating the thin ones or failing to remove the dendritic structure in the thick ones.

It was the writer's privilege in the fall of 1916 and the winter of 1916-1917 to visit nearly all of the important steel casting plants in the eastern half of the United States. It was also his privilege to have under his supervision the inspection of all the steel casting plants producing ordnance material for the United States army from January, 1918, until he left the service in March, 1919. As a result of this experience, he has come to feel to a greater and greater extent that the acceptance of steel castings should be placed on a broad basis and that the minute scrutiny of castings for a few hundredths of a

Paper presented by A. E. White at the Annual convention of the American Foundrymen's association held in Philadelphia, Sept. 29-Oct. 3. The author is a prominent member of the engineering faculty at the University of Michigan, Ann Arbor, Mich., and during the war was an officer in the ordnance department, where he had charge of steel foundry operations.

per cent of sulphur is both irrational and unwise.

To talk about the effect of an increase of 0.01 or 0.02 per cent of sulphur when by improper annealing, improper steelmaking or by improper foundry practice, properties many times worse than those produced by sulphur are acquired by the steel, is, in the writer's judgment, placing undue emphasis on the wrong factor.

Sulphur in steel may increase blow holes—it is granted that this is a disputed point—but assuming that it does, it will not do so to nearly the same extent as an improper temper to the mold; improper venting of the mold or core, especially the core; or an improper pouring temperature. It may increase shrinkage, but it will not do it nearly as much as an improper casting design, an improper pouring temperature, or too rapid a heating or cooling during the annealing. It may decrease the metal's resistance to shock but not to the degree that a poorly designed casting will, or one in which the metal has been overheated, burned or underannealed with the dendritic structure still in evidence.

It was because of the feelings expressed in the preceding paragraph that the writer championed, while connected with the ordnance department, a more liberal specification as applied to sulphur, though accompanied at the same time with such a method of inspection at the casting plant consisting of an examination of test bars, annealing lugs, visual examination, etc., that the real quality of the castings, or as near real as possible might be ascertained

Malleable Foundries Raise Their Standard

THE man who has become accustomed to manufacture a product and have it accepted by his customers without inspection or question does not, as a rule, take kindly to working according to specifications. At first there is usually a little resentment and a feeling that getting defective material by the inspector when possible is all part of the game of business. But after the manufacturer becomes used to working to specifications and begins to understand fully their importance to his own interests as well as those of his customers his entire viewpoint changes and he finds himself constantly striving to improve the quality not only of his own output but that of his competitors' as well.

Specifications requiring physical tests have been applied to rolled and forged steel in different forms for many years and the manufacturers have become accustomed to presenting evidence of quality, either through certificates of test or by having samples of the material tested in the presence of an inspector. But for some reason specifications on castings have seldom been demanded in the past and even now many castings are purchased without the buyer insisting on their meeting definite physical requirements.

Steel castings are purchased on specifications more frequently than others at the present time while gray-iron castings are least often purchased with test requirements. Malleable iron occupies a middle ground. Like all other castings those made of malleable iron are subject to great variation in physical properties if not properly made. In the past this fact has worked against the use of malleable castings in many places for which they are decidedly the most fitted. Some years ago, of all the foundries producing malleable castings, none was making iron having as good physical properties as it is practicable to attain, and frequently the castings had a tensile strength of less than 40,000 pounds per square inch.

Under these conditions many consumers, especially among the railroads, were loath to call for malleable where steel castings could be used. Some of the most progressive of the malleable iron foundrymen who were making a good grade of iron realized that something should be done to improve the quality of their own metal as well as that coming from foundries whose standards were low.

This question was brought before the American Malleable Castings association which decided to take steps to improve the general quality of the iron made by all its members and to assist those foundries among its membership which were making castings with physical properties below the average. In order to accomplish these ends arrangements were made, several years ago, with Prof. Enrique Touceda, Albany, N. Y., to carry on research work, test samples from member foundries, and to visit those foundries needing metallurgical advice.

Soon after the inauguration of this work the quality of the output began to improve in all of the foundries affected and those which were turning out the lower strength iron were helped to bring their metal more near the average of the other foundries. When these results were accomplished, the association began to urge higher requirements in specifications for malleable castings in order to inspire greater confidence among the users of this material

The members of the association are privileged to send daily samples to the laboratory of Enrique Touceda for test, and if the physical properties of the test pieces do not come up to the standard set by the association, the foundry making the particular iron is assisted to improve the quality of its metal. This system having proved successful, the association has recently taken another step to improve the quality of the malleable castings output of the country.

The new plan is to issue a certificate to each foundry which for three months has sent daily samples for test, in cases where every one of these samples has met the requirements of the association as to physical qualities. At present a minimum of 45,000 pounds per square inch tensile strength and 7.5 per cent elongation in 2 inches is demanded of foundries making railroad, motor vehicle, agricultural implement and general machinery castings.

For the quarter ended June 30, 1919, 32 members of the American Malleable Castings association out of a total of 62 have a continuous record for three months of meeting the requirements laid down. These requirements are the same as those given in the standard specifications for malleable castings of the American Society for Testing Materials.

Welding Gray Iron

By H. E. Diller

Question—We have difficulty in obtaining a soft, machinable weld on small gray-iron castings. Please inform us how to make a weld which will be soft and easily machined.

Answer—In welding small gray-iron castings care should be taken to have the entire casting heated to at least 200 degrees Cent. before starting to weld. Iron having 2.75 to 3 per cent silicon should be used for the welding rods. The casting should be cooled slowly after welding.

If you follow these instructions you should have no trouble but if you do experience any difficulty, heat the castings a little higher before welding and anneal them at 500 degrees Cent. after the welding is finished. The castings should be cooled slowly as indicated.

Making Steel in the Iron Foundry

A Side Blow Converter Installed in a Gray-Iron Foundry Could Take Care of Miscellaneous Cast Steel Requirements—Low First Cost of Converter an Advantage

BY GEORGE P. FISHER

STATISTICAL reports of the American Iron and Steel institute, classifying the steel castings produced in the United States according to the process used for melting and refining, contain the following production figures in gross tons for 1916 and 1917:

	1916		1917	
	Gross Tons	Per Cent	Gross Tons	Per Cent
Open-hearth ...	1,176,449	85.76	1,213,156	84.16
Converter	142,791	10.41	159,272	11.05
Crucible	9,351	0.68	3,834	0.26
Electric furnace..	42,870	3.12	64,911	4.50
Miscellaneous ...	302	0.03	231	0.02
Total	1,371,763		1,441,407	

At the date of this paper the figures for 1918 have not been published.

Each of the three principal processes for the manufacture of steel castings has advantages and disadvantages as compared with its rivals, and each has its own separate and distinct field of operation. As shown by the above figures about 84 per cent of the tonnage of steel castings is credited to the open-hearth furnace, 11 per cent to the converter, 4.5 per cent to the electric furnace and 0.5 per cent to the crucible and miscellaneous.

Any foundry proposing to manufacture steel castings must consider which process will prove most economical and satisfactory for its particular class of work. With a proper selection of raw materials and the requisite amount of care and skill, good castings can be produced by all three processes, and it is equally true that without proper care and skill very poor castings can be produced by any of the processes mentioned.

Practically all heavy castings, by which we mean those weighing from 500 pounds up, and having sections of ½ inch or more, are cast from open-hearth metal. Where large tonnages are desired and where the sections of metal permit the use of relatively cold steel, without excessive loss due to misrun castings, this process is usually the first choice. It is considered essential for economical operation that the furnace be operated continuously for 24 hours per day and when conditions permit this, open-hearth steel can be made at a lower cost than steel by any other process. An open-hearth shop requires relatively more floor space per ton of castings produced because the heats are larger and are tapped at less frequent intervals.

Steel foundries are classified roughly as those specializing on heavy work and those specializing on small light work. In the latter class we invariably find the electric furnace or the side-blow converter. These two processes practically monopolize this field because of the extremely high temperature attainable in the melted metal by either of them. With either the electric furnace or the converter no difficulty is encountered in tapping steel at from 3000 to 3200 degrees Fahr., which permits the manufacture of castings weighing as little as 2 to 3 ounces each, and having sections as light as ⅛-inch. The modern steel foundry specializing on light work accepts orders for castings which used to be considered too small and intricate for any but malleable foundries.

Electric Furnace

The arc-type electric furnace has become an important factor in the steel casting industry since 1915, during which year 23,064 gross tons of steel castings were made in electric furnaces. Furnaces of this type are able to produce metal of sufficiently high temperature to cast the lightest and most intricate castings, and can be operated with either basic or acid linings. Because of their neutral non-oxidizing atmosphere they can use very light scrap or even steel turnings. A few electric furnaces are known to be charging 100 per cent scrap and borings, and all of them are using a very high percentage of old metal, probably 85 per cent or more.

A very high degree of metallurgical skill is necessary for the successful operation of an electric furnace, and for economical results the furnace should make steel continuously for 24 hours per day. Only by continuous operation can reasonable power costs be maintained, and the cost of power is one of the most serious considerations in producing electric steel. Even when it can be obtained at as low a cost as one cent per kilowatt-hour, the power cost per ton of metal melted, with good practice, is in the neighborhood of $6.50 to $7.50. With poor practice the costs are very much higher. Electric furnace manufacturers publish figures showing that electric furnace metal can be produced at a cost about on a par with open-hearth steel and about one cent per pound lower than converter steel. These figures no doubt hold good under conditions of continuous furnace operation and cheap power rates, but not under ordinary conditions.

The side-blow converter is in operation in about 100 steel foundries in the United States. It has been used for the manufacture of small steel castings for nearly 20 years and the production of castings has increased from 14,000 tons in 1903 to 159,000 tons in 1917. Only the electric furnace can compete with the converter in producing temperatures which permit the casting of very light sections and small intricate shapes. The great advantage of the converter over all other processes lie in its great flexibility, ease of operation and small initial investment. It can be placed in operation on an hour's notice and can produce 20 heats per day or only two or three at practically the same cost per heat. Heats are blown in from 12 to 15 minutes each. When not in operation it requires no attention and the only costs against an idle converter are depreciation and interest on investment, both of which are negligible. The heats are small and produced at short intervals, permitting floor space to be used over several times during the day.

The usual charge in converter practice consists of 40 to 50 per cent of pig iron and 60 to 50 per cent of scrap. The author has seen a converter operated successfully on 100 per cent of steel scrap by adding ferrosilicon to bring the silicon content to the required figure. Because the converter must be operated with an acid lining, it is necessary to purchase raw material having a low phosphorus ard sulphur content.

Many plants operating an iron foundry have a demand for steel

Paper presented by George P. Fisher at the annual convention of the American Foundrymen's association held in Philadelphia, Sept. 29-Oct. 3

castings. Where this demand is intermittent and not for a large tonnage, the side-blow converter is an ideal installation. The melting equipment for the gray iron foundry and for the converter steel foundry is the cupola, which is already installed. When steel is required the metal can be melted in the same cupola ahead of the gray iron mixture. The converter occupies very little floor space and requires no attention when idle.

In the case under discussion we are assuming a demand for a small tonnage and in this case initial investment is worthy of serious consideration. The converter can be installed and put in operation for approximately one-sixth of the cost of an electric furnace and one-half to one-third the cost for an open-hearth furnace.

Perhaps the most important factor is the ease with which a converter can be operated. It is unnecessary to employ a high-priced furnace operator who is of little or no use when there is no demand for steel. The foundry foreman or any intelligent employe can be trained in a very few weeks to operate a converter and produce good steel. If only two or three tons of castings are required per day the time necessary to blow the steel takes perhaps an hour per day of the foreman's time, which interferes with his regular duties only to a very small extent.

Because of the speed with which steel can be produced and the high temperature of the metal it is possible to accumulate two or three blows from one converter in the same ladle to pour an occasional large casting. This is impossible by any other process for making steel and is a great advantage in a shop where it is impossible to predict what size of casting will be demanded. While large castings weighing several tons each can be made as just described from a 2-ton or even a 1-ton vessel, the converter finds its greatest application in the manufacture of small and very light-sectioned castings.

Threaten Increased Duty on Graphite

RECENTLY two bills were introduced in the house of representatives, which provide an increased duty on imported graphite and fire clay suitable for use in the manufacture of crucibles and other foundry supplies. The tariff proposed would be from one cent per pound up to six cents per pound according to the grade of the material. The apparent object of these bills is to protect the miners of domestic graphite but this legislation if passed would tend to work a serious hardship on the foundry business as well as on other industries using graphite. The Foundry Supply Manufacturers association has taken up the question in order to show what effect the passage of the bills would have upon the foundry business and indirectly upon the cost of manufacture in all lines using foundry products.

The bills as introduced read as follows:

"H. R. 5941.—A bill to provide for the national security and defense by encouraging the production and refinning of graphite (plumbago, silver lead) ores in the United States and in its possessions, and to provide revenue for the government of the United States.

"Be it enacted by the senate and house of representatives of the United States of America in congress assembled, that on and after the day following the passage of this act there shall be levied, collected, and paid upon the articles named herein, when imported from any foreign country into the United States or into any of its possessions, the rates of duties which are herein prescribed, namely:

"First.—Crude graphite ores, crystalline or amorphous, 1 cent per pound of ore for ores containing 50 per centum or under of graphite carbon, 2 cents per pound of ore for ores containing over 50 per centum of graphitic carbon, the term crude graphite ores being defined for the purposes of this act as ore which has not been subjected to any process of refining or concentration which changes the graphite content of the ore as mined.

"Second.—Lump and chip crystalline graphite (plumbago, silver lead), 3 cents per pound of graphite, the term lump and chip being defined for the purposes of this act, as larger crystals of graphite more or less broken up in mining and treatment, of a size which will not pass through a screen with openings one-quarter of an inch square.

"Third.—Flake crystalline graphite (plumbago, silver lead), crude concentrates and refined flake, 6 cents per pound of graphite, the term flake being defined for the purposes of this act as smaller crystals of graphite more or less broken up in mining and treatment, of a size which will pass through a screen with openings one-quarter of an inch square.

"Fourth.—All other products, manufactured materials, and compounds containing graphite, crystalline, or amorphous, not specifically provided for in this act, 5 cents per pound for the graphite contained therein."

"H. R. 5547. A bill to repeal paragraph 450 of an act entitled 'An act to reduce tariff duties and to provide revenue for the government, and for other purposes,' approved Oct. 3, 1913.

"Be it enacted by the senate and house of representatives of the United States of America in congress assembled, that paragraph 450 of an act entitled 'an act to reduce tariff duties and to provide revenue for the government, and for other purposes,' approved Oct. 3, 1913, be, and the same is hereby, repealed.

"Sec. 2.—That on and after the day following the passage of this act there shall be levied, collected, and paid upon all clay suitable for or used in the manufacture of graphite or other crucibles, or used in the manufacture of glass melting pots or tank blocks, when imported from any foreign country into the United States, or into any of its possessions except the Philippine islands and the islands of Guam and Tutuila, a duty of 10 dollars per ton."

As will be seen from a study of these bills the price of imported graphite and of clays for crucibles would be materially increased. Graphite, silver lead or plumbago, as it is called in the foundry industry, is used in foundry facings and for finishing molds and the imported varieties would be increased 50 per cent in cost. Graphite also enters into the manufacture of crucibles used in brass and other nonferrous metal casting shops and in the manufacture of crucible steel. The cost of such crucibles would not only tend to be increased by the cost of graphite but also by the extra cost of clays as provided by one of the proposed laws.

It is estimated that fully 80 per cent of the graphite used for foundry facings is imported. So far no graphite has been found in this country of a quality which will fully replace the foreign graphite obtained from Ceylon, Canada and Mexico, either for foundry facings or for crucibles. This was made apparent in regard to crucibles during the war when it was next to impossible to obtain crucibles which would have more than half the length of life of the crucibles made previous to the war from foreign graphite and clays. The necessity for having the proper grade of graphite for facing molds is seen when a rough, scabby casting results from the use of an inferior grade of facing.

Unfortunately graphite cannot be worked over to secure the grade desired as is the case with many grades of ore which can be made into any kind of steel according to the process used; but little can be accomplished in the way of securing a high-grade graphite from one which is inferior as it comes from the ground. This leaves little alternative but to use an inferior grade of domestic graphite or to import material of the quality desired and pay the increased price.

How and Why in Brass Founding

By Charles Vickers

Alloying Lead With Zinc

We have a large quantity of white-metal scale weights to make weighing ½, 1 and 1¼ pounds each. The specifications demand an alloy of 90 per cent zinc, and 10 per cent lead. We have not been able to get the lead to mix with the zinc, although we have tried various ways. The lead always goes to the bottom of the pot. We would like, therefore, to know if this mixture can be made, and if so, how. We presume these weights are specified in zinc to have a cheap, hard metal, and the lead is specified to add weight and take up some of the shrinkage. If this mixture cannot be made we would like to have you suggest a cheap, hard mixture that could be used in its place.

Lead and zinc only alloy in limited proportions, much less than 10 per cent lead to 90 per cent zinc, therefore, while it may not be impossible to get these metals to remain together in the percentages named, it will never be done by simple melting and stirring the two metals. The two metals have no affinity for each other and the result is that the lead settles to the bottom when the molten, mixed metals are allowed to stand. We, however, would not like to go on record with the statement that these metals cannot be held together in any proportion, because the case is very similar to that of copper-lead alloys, and aluminum-lead alloys, the lead will separate from all of these metals, but in practice alloys of copper and lead are being made containing all proportions of lead. Some of these alloys resemble babbitt, but have a high melting point because high in copper. In the case of aluminum-lead, alloys of these two metals are being made containing up to 10 per cent lead. To make these mixtures is a trick in alloying, known to those who have studied the matter and have done the necessary research work. Naturally, information on the subject is difficult to get, as the secret is guarded by those who possess it. Alloys of lead and zinc possess no commercial importance, therefore, few have done any experimental work to learn how to hold the metals together when solid. It could no doubt be done by the addition of some third metal that had affinity enough for both lead and zinc to hold them together. In this connection, possibly magnesium would be worth a trial. We believe that as a very cheap alloy is demanded the addition of a third metal would make the alloy too costly, and that the better way would be to make an alloy of zinc 98.50 per cent, lead 1.50 per cent, and to enlarge the patterns to compensate for the lower specific gravity of this alloy, as compared with the alloy specified.

The weights could also be cast in the ordinary leaded zinc used for making common brass, and brought up to weight by pouring lead into cavities made for the purpose.

Formulas for Muntz Metal

Can you advise us regarding the composition of Muntz metal, or where same can be purchased?

Muntz metal is a yellow brass first used extensively as a sheet metal for sheathing ships. It was patented in England in 1832 and was named after the inventor. The first specifications were copper 60 per cent; zinc 40 per cent. A third patent in 1846 specified, copper 56 per cent; zinc 40.75 per cent, and lead, 3.75 per cent.

At the present some makers claim the zinc should not be higher than 38 per cent. The following are analyses of two alloys:

	Per cent	Per cent
Copper	60.52	59.52
Zinc	38.80	39.43
Lead	0.40	0.74
Nickel	none	0.39

For casting purposes use copper, 58.50 per cent; zinc, 40.00 per cent; tin, 0.50 per cent, and 10 per cent aluminum bronze, 1 per cent.

Muntz metal can be purchased from any concern specializing in ingot metals.

Bronze Propeller Mixture

We would like to have a good mixture for a bronze propeller.

The mixture will vary depending on the diameter of the propeller desired.

The best alloy to use for propellers is manganese bronze, but it must be of the highest grade and not simply a yellow brass with a little aluminum added. For a small propeller a good grade of red brass can be used, and suitable alloy is the following: Copper, 88.50 per cent; tin, 6.50 per cent; zinc, 3.50 per cent, and lead, 1.50 per cent.

Alloy for Match Plates

Can you advise as to a satisfactory material for making patterns for match plates?

For making patterns for match plates a white metal is very satisfactory. Such an alloy can be made of zinc, 50 per cent and tin, 50 per cent. Melt the zinc first, then add the tin gradually. Before adding the tin however it is advisable to add a piece of sheet aluminum 2 inches long and 1 inch wide, the thickness of ordinary cardboard. This alloy is suitable as it possesses so little shrinkage that rapping of the master patterns before drawing them out of the sand usually makes up for the shrinkage.

For the pattern plates themselves, use aluminum alloy of the composition, aluminum, 92 per cent; copper, 8 per cent.

Sometimes the match and patterns are cast solid of plaster of paris, in which case a drag is rammed up and the joint finished carefully, then an interchangeable cope is placed over the drag, and is filled with plaster. When set the patterns are trimmed and shellacked. Two blocks are required, one for the cope and another for the drag.

Formula for Roll-Neck Bearings

We would like to obtain the formula for a bronze for roll-neck bearings, to be cast in iron molds. These bearings are not for heavy duty rolling. The largest rolls are approximately 12 x 36 inches.

The following formula will give a bronze that will be suitable for the purpose outlined: Copper, 86.50 per cent; tin, 8 per cent; lead, 5 per cent, and phosphor copper, 0.5 per cent. The phosphor copper should contain 15 per cent of phosphorus. If the alloy fails to run as well as desired, the phosphorus can be increased, deducting the increase of phosphor copper from the copper content of the alloy.

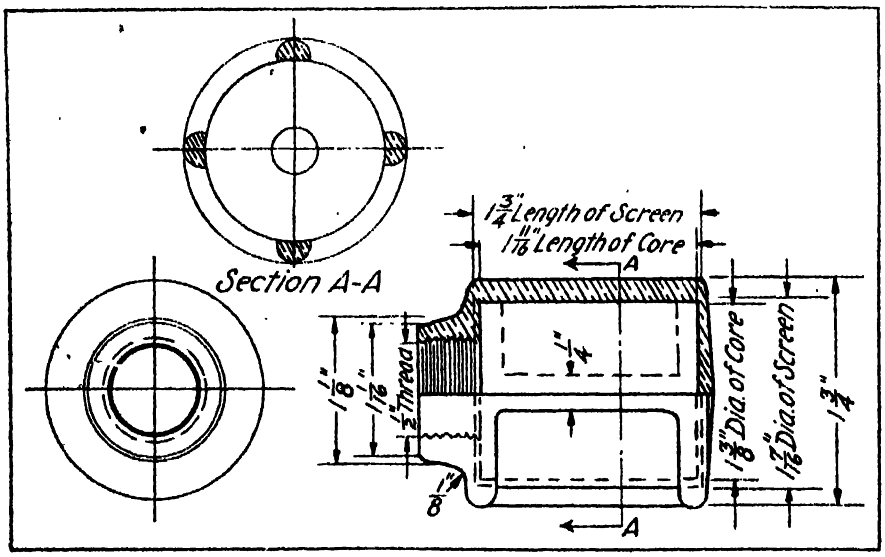
Prepare the chills by warming them and then painting with a mixture of lard oil and plumbago, thin enough to flow from the brush. Apply a layer of French chalk over the oil and plumbago with a smooth camel-hair brush. Have a heavy riser in a dry sand head.

Casting Defects Remedied by Changing Gate

We have experienced considerable difficulty in getting good castings for the pipe strainers shown in the illustration. The castings consist of a brass cage ***with solid bottom and a circular,*** *threaded top, and the sides of the cage are formed of brass screen held in place by the ribs on the casting which join its bottom and top. The screen is cast in place being wrapped around the core, which shapes the inside of the cage. The difficulty consists of cold shuts and misruns. The percentage of loss is high.*

We use scrap yellow brass with possibly some valves thrown in, which is melted in an oil-fired furnace. We ***add several ounces of aluminum to*** *aid in running the metal but there is no phosphorus present. The machining qualities have been good until recently when only 10 castings could be threaded per tap. One lot analyzed as follows: Copper, 76 per cent; zinc, 22.10 per cent; iron, 0.60 per cent; lead, 1.20 per cent; tin, trace. Can you suggest a cheap mixture or something to add to the mixture to give it fluidity and thus overcome misruns and coldshuts? Please explain the effect of common salt on the melting of brass, also the effect and the advantage of using boron, and what effect lead has on the machining quality of brass in different percentages Does a brass with as high a lead content as 20 or 30 per cent resist machining by becoming gummy?*

It is assumed these strainers are cast horizontally with the parting line of the mold passing through the centers of two opposite ribs, which leaves one rib at the highest point of the cope. If the strainers are made this way the rib at the highest point will be the one to misrun most often. If the castings are placed lengthwise of the flask and the mold is tilted, a gate at one end and entering the side of the casting will run them. But if the gate is cut so as to form an acute angle with the runner so the metal can shoot into the strainer, the castings at the top of the mold which are nearest to the sprues, will be misrun in the majority of cases. This is due to the fact that the metal does not fill the strainer when it shoots in but passes on down the runner and leaves a little metal in the upper strainer molds, which of course immediately sets. If the gates are so adjusted on the plates it would be better to pour the molds on the level with the sprue at one end. In pouring the molds on the level it is better to locate the sprue in the center of the mold, provided the branch gates to the castings are set for center pouring, and allow the metal to shoot into the castings in both directions from the center of the runner. If the molds are to be tilted with the sprue at the highest end the two lower castings may be gated so the metal shoots into the strainers, although this is a debatable point The gates leading to the castings higher up along the runner must be so cut that the metal will shoot past them and strike the bottom of the runner first, then as it floods back it will fill all the upper strainers uniformly and there will be few coldshuts. It is difficult to decide without a test just what is the best way to run these castings; whether on the level or on an incline. but if they are poured on the level we believe it would be the best to center gate them; that is pour from the center of the mold. In the latter case it would be well to increase the height of the pouring head if possible to do so without adding to the molding costs. If this is not possible the metal will have to be poured rather hot and poured very decisively.



PLAN AND SECTIONAL VIEWS OF PIPE STRAINER CASTINGS

We would also suggest a trial of the following alloy for these castings; copper, 56.50 per cent; zinc, 40 per cent; lead, 3 per cent; aluminum, 0.50 per cent. If the alloy does not cut with sufficient ease, the lead can be increased to 5 per cent at the expense of the copper. Then if the metal appears too brittle the zinc should be lowered a little. Also before weighing the flasks, take a gate cutter and cut a channel in the sand of the cope over each row of castings. This lets the gas off and greatly aids in running the castings. The reason the alloy the analysis of which is given, is difficult to machine is due to the iron content. The high per centage of iron is obtained from the scrap. This is one great objection to the use of scrap for such castings. for by increasing machining costs a mixture using scrap often makes the castings more costly than if they had been made entirely of new metal.

Salt protects brass when melted with it because the salt volatilizes and fills the crucible and a part of the furnace with fumes. These fumes are so persistent that once salt is added in quantity it can be detected for several melts, even if no more is added.

Boron has no effect on brass because like carbon it is insoluble in copper and its alloys. Its salts such as borax and boric acid makes good fluxes as they dissolve oxides, but should not be used in quantity as then they would carry away copper. Metals that absorb and retain carbon, absorb and retain boron, thus aluminum and iron take up boron, and so does nickel, but if boron aluminum that is brittle with boron is added to copper the boron is lost by being thrown out and oxidized immediately and absolutely no effect is obtained by adding the boron. The effect is exactly the same as when cast iron and copper are melted together; the two will not mix because the iron has a greater affinity for its carbon than it has for copper but if aluminum is added the copper and the iron unite and the carbon held by the iron is released and bobs to the surface of the melt as a flocculent dross. The aluminum acts as a cement because it combines eagerly with both copper and iron. The effect of lead is to improve the machining qualities of brass in all proportions. Alloys containing as much as 66 per cent of lead are white in color and machine perfectly.

Getting Ready for Huge Production

Details of Plant Built Expressly to Handle a Large Tonnage of Motor Castings Expeditiously — Forced and Induced Draft Used in Drying the Cores — Castings Poured Continuously

BY PAT DWYER

IF Pere Marquette, the black-robed Jesuit, could have looked into the future while engaged in that perilous search for the sources of the Mississippi, he would have felt both gratified and disappointed. His explorations in the country now called Michigan were carried on under the impetus of the society's motto, "for the greater glory of God," and his own patriotic desire to acquire new territory and thus add to the power and prestige of France. He would have been gratified to know that the land which he claimed in the name of his Louis XIV was destined to become great, rich and prosperous from the exploitation of her apparently inexhaustible lumber and mineral resources, but he would have felt disappointed because she was destined to pass so soon and forever from under the aegis of the Fleur-de-lis.

The immense forests, which forced Marquette to do all his traveling by birch-bark canoe, laid the foundation in the lower peninsula for the growth of Detroit, Saginaw and Bay City. Millions of feet of white pine floated down the rivers and were squared into lumber.

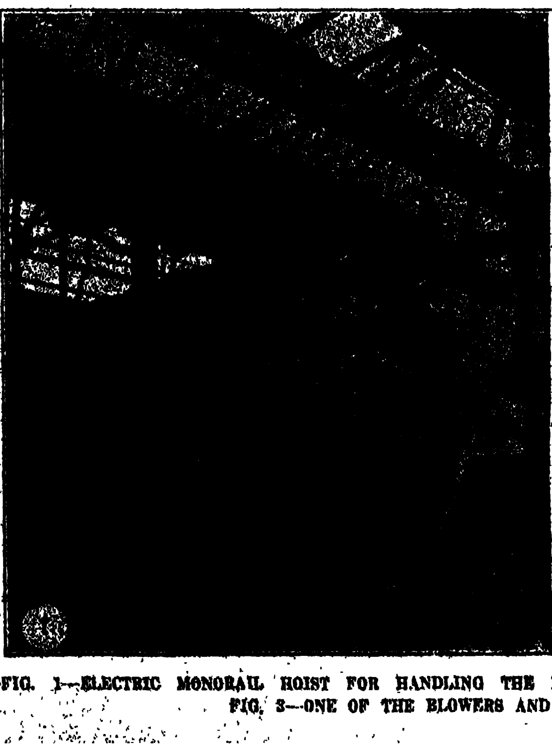
The picturesque rivermen, with their little cocked hats, peavies and spiked shoes are becoming a thing of the past and the lumber industry although still important, is no longer in the limelight. The manufacture of motors and motor-cars is now the premier industry of Michigan. Immense plants have been erected in various parts of the state for this purpose and in spite of their tremendous output they cannot keep pace with the demand. Large foundries are operated in connection with nearly all of these plants.

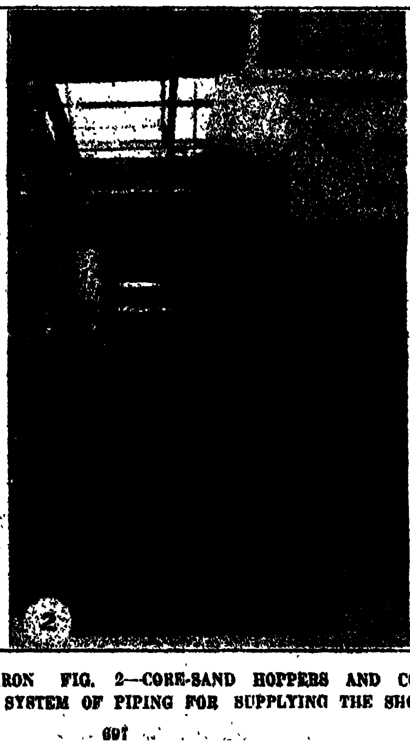
One of the finest and most modern of these foundries has been built recently in Saginaw, Mich, at a cost of $3,000,000, for the Saginaw Product's Co., a subsidiary of the General Motor's Corp. This foundry was designed by Frank D. Chase, Inc., industrial engineers, Chicago, and built under their supervision. The property assigned for foundry development is served by several spurs from the Pere Marquette railroad and covers 65 acres. The present plant covers approximately one-third of this area and it is the intention of the company eventually to erect two other similar units, thus utilizing the entire property. The first unit now completed, is expected to furnish employment for 900 men who will turn out 200 tons of cleaned castings daily.

Many of the appliances and special features about the plant were installed at the suggestion of J. J. Wilson, general foundry superintendent for the General Motor's Corp., who drew on his unusually wide experience in the production of automobile castings.

The group of buildings comprising the first unit consists of a foundry building, 165 x 450 feet; a cupola room, 40 x 163 feet; a coreroom, 101 x 390 feet; a cleaning room, 110 feet 6 inches by 281 feet 9 inches; a 2-story pattern building, 158 feet 10 inches by 100 feet; and a washroom, dining room and office building, 261 feet 6 inches by 80 feet 3 inches. The powerhouse is situated 100 feet west of the cleaning room. One of its outstanding features is a radial brick stack 225 feet high by 9 feet in diameter at the top. This building takes the shape of an L, 86 feet 6 inches by 93 feet 9 inches.

The walls of the buildings are of brick and steel construction while the roofs are built of gypsum tile. This material is a non-conductor and prevents condensation. An A-frame on the roofs of the coreroom and cleaning room and a modified Pond truss on the foundry building, together with an almost con-





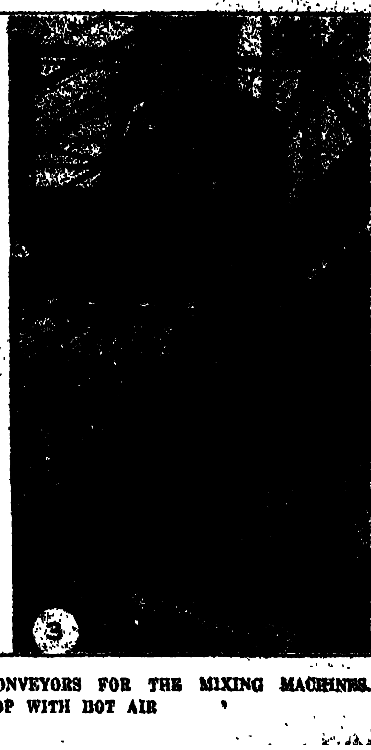


FIG. 1—ELECTRIC MONORAIL HOIST FOR HANDLING THE IRON FIG. 2—CORE-SAND HOPPERS AND CONVEYORS FOR THE MIXING MACHINES. FIG. 3—ONE OF THE BLOWERS AND SYSTEM OF PIPING FOR SUPPLYING THE SHOP WITH HOT AIR

tinuous sash in the walls insures ample light on the floors. In addition, the buildings are all painted a light yellow on the inside which renders the lighting conditions ideal. The sash in both walls and roof are movable and are operated electrically. This simplifies the ventilation problem to a considerable extent.

A group of three 600-horsepower Edgemoor boilers supplies steam for heating the buildings and also for operating three direct steam-driven Ingersoll-Rand air compressors, two being 1500 and one 1200 cubic feet capacity. Coal is used for fuel. It is taken from the cars and passed through a crusher, after which it is lifted into a hopper by a bucket conveyor. From the hopper it is fed to the boiler-room by gravity through a chute.

Electric power, which is purchased from outside interests, is supplied at 2200 volts, 3-phase, 60 cycles. The connected load totals 1400 horsepower, the lighting load being 150 kilowatts. Three transformers step down the voltage to 440 volts for the power load while a smaller set handles the lighting load. By means of a motor-generator set, direct current is supplied for operating the cranes. The generator sets, which are duplicated to cope with emergencies, are housed in a room in the northeast corner of the foundry building.

Since cores enter so largely into the production of automobile castings it is only natural that the coreroom of this plant should occupy nearly as much space as the foundry. It is the same length as the foundry and only 53 feet less in width. The 32 core ovens were built by Holcroft & Co., Detroit. They are arranged back to back with eight in a row making two batteries of 16 each. Each oven is 12 by 6 feet 6 inches by 7 feet. A continuous flue runs under each row of eight ovens, terminating in an individual stack. There are two openings in the floor of each oven connected with the flue. They are provided with dampers controlled by chains which hang down outside the door. Two outlets are provided in the side walls for the gas and steam, one opening near the top and the other below the floor level. These openings are provided with slides operated from the outside. With these dampers it is possible to control the temperature in the oven quite closely. A pyrometer is attached to each oven in order to keep a record of the heat fluctuations.

The fire boxes for the ovens are in the basement. A long concrete incline leads from the coke storage outside the building down to the basement floor and coke is taken down for the fires and the ashes removed in wheelbarrows. The firing pit, flues, and draft facilities are so perfect that it does not require any more coke to fire a battery of eight ovens than it does in some foundries for a single one. Both forced and induced draft are employed. The firing room in the basement is furnished with air-tight folding doors. Whenever it is necessary to increase the draft these doors are closed and the air pressure raised by a fan, on the same principle as that in use in the fireroom of a battleship.

The stack for each battery of ovens is situated at the opposite end from the fire box. They are clearly shown in Fig. 5. This illustration also shows a fan driven by a 15-horsepower motor, connected to both stacks and used to furnish the induced draft necessary. The cores are loaded on racks and taken in and out of the ovens on electrically operated trucks.

The ovens are situated midway from both ends of the building. Their general appearance and relative size in comparison to size of the building are shown in Fig. 8. Provision has been made for doubling the number of ovens if necessary. The basement extends under the space required for additional batteries, a temporary brick wall shutting off the space used at present in order to render it air tight when the forced draft is in use.

Among the many kinks to be found around this plant may be mentioned the cams shown on the posts beside the oven doors. When these cams are thrown up the door has plenty of latitude in the guides and will not jam when being pulled up or down; when the handles of the cams are pulled down they force the door tightly against the guides thus preventing any of the heat from escaping.

Core-oil is stored in a large tank below the ground level, immediately outside the south wall of the coreroom and in line with the core ovens.

The core sand is stored in four concrete bins each 25 x 63 feet having a total capacity of 8000 tons. They are roofed over and the sand transferred to them from the railroad cars by means of grab buckets having a capacity of 1¼ cubic yards each. Each pair of bins is served by a 5-ton Pawling & Harnischfeger crane. Adjacent to the bins and opening into the coreroom are three double hoppers, that is each hopper has a dividing wall in the center. These hoppers, which are loaded from the sand bins on the outside by the cranes, discharge on the inside of the building into a battery of mixing machines. Front and side views of the hoppers and machines are shown in Figs. 2 and 7. There are two revolving screens and mixers built by the Standard Sand & Machine Co., Cleveland, and one No. 2 Simpson pan mixer built by the National Engineering Co., Chicago. The Standard machines are equipped with worm conveyors and bucket elevators for lifting the sand from hoppers in the floor to the screens. Each mixing

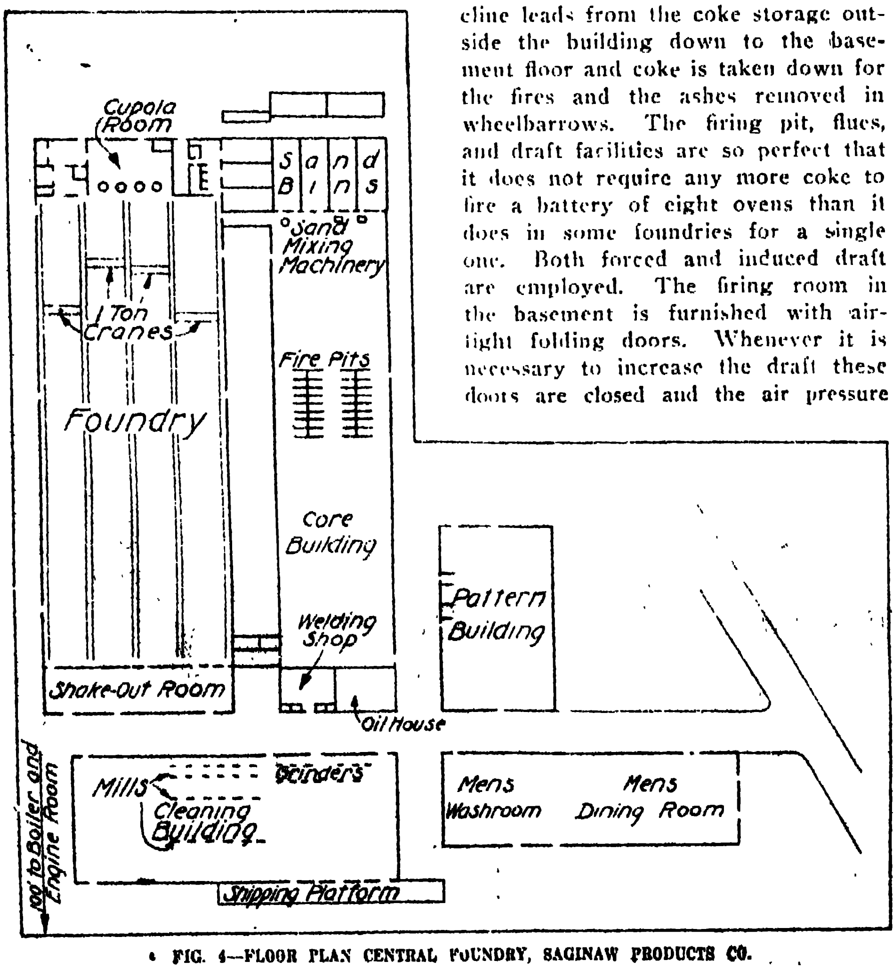
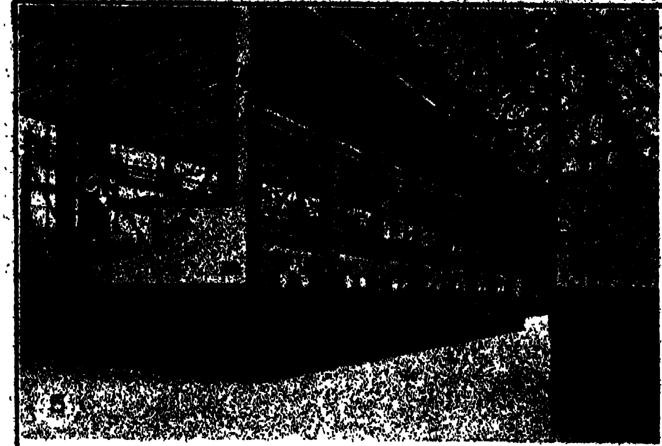
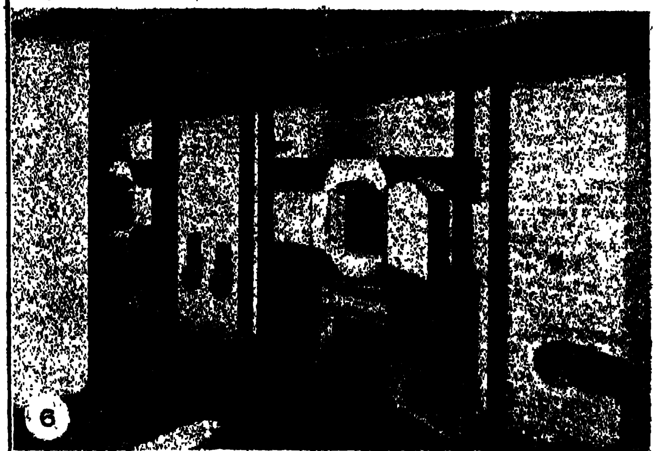
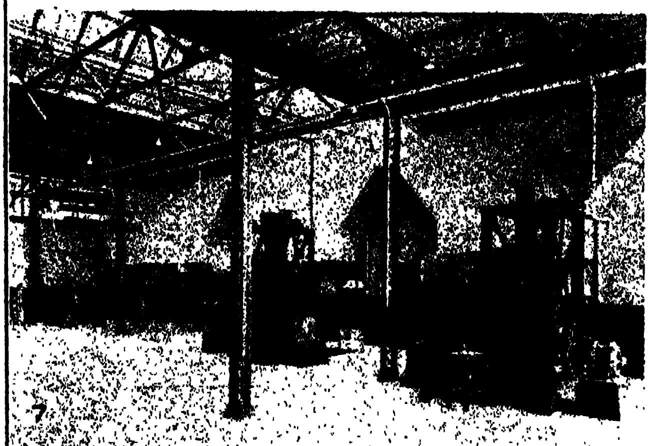


FIG. 4—FLOOR PLAN CENTRAL FOUNDRY, SAGINAW PRODUCTS CO.







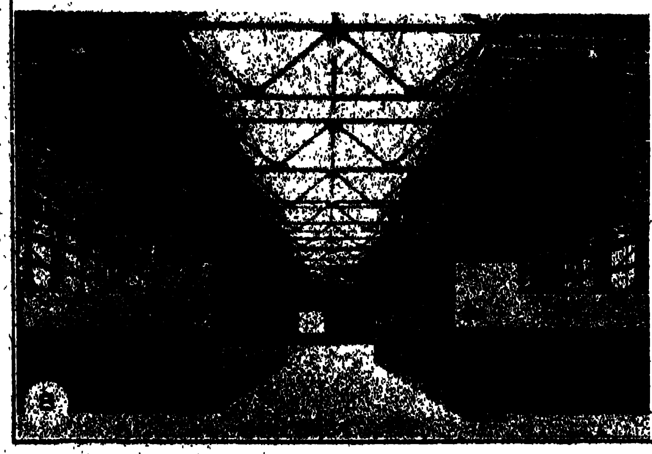



FIG. 5—ONE OF THE BATTERIES OF CORE OVENS, SHOWING THE UPPER FLUES, THE STACKS AND THE FAN FOR SUPPLYING INDUCED DRAFT FIG. 6—FIRING ROOM FOR OVENS. FIG. 7—CORE SAND HOPPERS AND MIXING MACHINERY FIG. 8—TWO BATTERIES OF OVENS ARE PROVIDED FIG. 9—CORE SAND BINS AND HOPPERS FIG. 10—COURT BETWEEN COREROOM AND FOUNDRY FIG. 11—FOUNDRY INTERIOR LOOKING TOWARD THE CUPOLAS FIG. 12—FACING SAND MIXERS

unit is driven by an individual motor.

The coreroom and foundry buildings, which are parallel, are separated by a court, as shown in Fig. 10. This court is 40 x 360 feet and is paved with concrete. It facilitates the lighting of the two buildings which face each other. The two buildings are connected at both ends, at the east end by a structure housing a series of bins for holding molding sand and at the west end by a building in which dust arrester exhausters are installed.

Arrangement of Foundry

The foundry building, which is divided into four bays, has a total length of 490 feet 4½ inches and a total width of 164 feet 4 inches. Included in this however, is a space 60 feet wide at one end containing the motor-generator sets for the cranes, as well as the elevator, the cupolas, the charging floors, and the installation for mixing facing sand. At the other end there is a room 40 feet by 125 feet 4 inches where the castings receive a preliminary cleaning.

The foundry has a modified Pond truss roof and like the coreroom has adequate lighting, heating and ventilating facilities. The floors are composed of wood blocks and the gangways are paved with asphalt blocks.

The molding room is divided into four bays by the three rows of columns. The floors are further subdivided by a series of gangways which, like the molding floors, extend the whole length of the shop. Each molding floor is 24 by 380 feet; the center aisle or gangway is 23 feet wide, the pouring aisles, which come under the monorail, are 9 feet each, and the outside aisles next to the walls are each 12 feet 7 inches in width.

At *A* Fig. 3 is shown one of the installations for heating the building by the indirect hot-air system. Two No. 8 American sirocco blowers are provided. Each blower is driven by a 10-horsepower General Electric motor. The fan units are located near the center of the foundry which permits of a most economical and satisfactory arrangement of hot air ducts. Each unit is capable of delivering 28,000 cubic feet of free air per minute. In addition to this indirect system, the building is heated directly by steam which is supplied to a series of radiators occupying the space between the windows and the floor all around the outside walls.

Water, air and electric current are available at every other column. A 4-inch pipe line is laid the full length of the shop under the center of each floor; it is provided with 2-inch connections at 8-foot intervals which simplifies the setting up of a molding machine anywhere. Foundations for the permanent jarring machines are provided at each end of the shop. The continuous pouring system is to be employed and therefore each set of machines will be used alternately. The same idea will be carried out with the portable machines; they will travel down one side of the shop and up the other.

The castings will be shaken out and conveyed to the cleaning room on electric trucks. Bubbling fountains supplied with artificially cooled water are set up at convenient intervals, also several urinals are provided near the middle of the shop. Several 1-ton cranes with air hoists and one 3-ton Pawling & Harnischfeger crane spanning the center bays, comprise the lifting equipment. Most of the work is light and these cranes will be used principally for handling molds and pouring. A complete monorail installation will be used to distribute the iron to each bay. Four 2-ton hoists built by the Sprague Electric Crane & Hoist Co., New York, and similar to the one illustrated in Fig. 1, are employed for this purpose. In this style of hoist the operator not only drives the crane, he also tilts the ladle and fills the small ladles which are used for pouring the castings.

There are three molding sand bins, each 25 x 40 feet. The facing sand is mixed in a room situated between these bins and the cupola room. The mixing machinery, which is shown in Figs. 12 and 13, is in duplicate. Both the revolving screens have false bottoms controlled by levers. The correct amount of old and new sand and seacoal is measured out on the floor for one batch of facing and then shoveled into the screen. When it has all passed through, the lever *E* is reversed and the sand falls into a pocket from which it is carried to the upper floor by the aid of a screw conveyor and bucket elevator. Here it falls into a No. 2 Simpson pan mixer, from which it is carried by another bucket elevator to a centrifugal mixer built by William Sellers & Co., Philadelphia. It is then considered finished and drops down a chute through a hole in the floor back to a bin on the ground floor. A storage bin, 20 x 40 feet, is provided near the mixer for holding seacoal.

The four Whiting cupolas provided for melting the metal are shown in Figs. 17 and 18. Three of them are alike, with 90-inch shells lined to 65 inches at the bosh and 52 inches at the tuyeres. The fourth is 56 inches in diameter lined down to 40 inches. Each cupola is provided with two sets of tuyeres, the lower set being continuous. The charging platform is 24 feet above the ground and the spark arrester with which each cupola is crowned is 67 feet above the foundation. The concrete foundations for these furnaces are 11 feet square and 6 feet deep. It is calculated that when fully charged each cupola weighs 130 tons.

The blast is furnished the cupolas by three No. 6½ positive pressure blowers built by P. H. & F. M. Roots, Connersville. Each blower is driven by an individual 75-horsepower General Electric motor. They run at 175 revolutions and deliver 8300 cubic feet of free air per minute. The three blowers discharge into a common 36-inch header. From the header, 26-inch pipes lead to each of the large furnaces and a 10-inch pipe to the small one. Blast gates are provided between each furnace on the header and again immediately before each pipe enters the windbox. Each gate is operated by a rack and pinion.

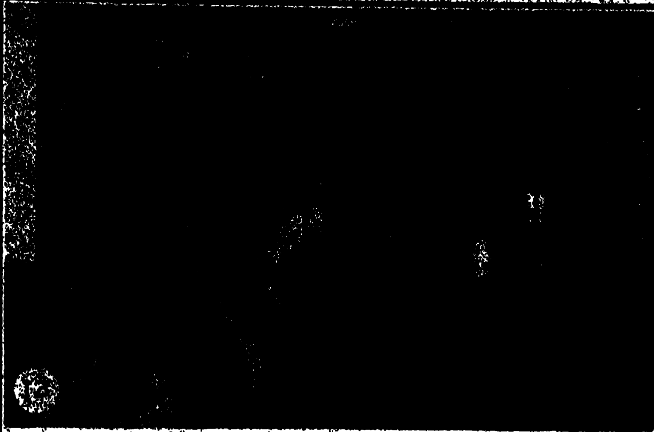
A narrow-gage industrial track with a spur running under each furnace is used for hauling away the slag and cinder from the cupola drop. Back of the cupolas, but under the same roof, is a bin for holding the clay used in daubing the furnaces and ladles, and in an opposite corner there is an oven for drying the ladles.

The main charging floor is shown in Fig. 15. It is provided with two Howe platform-scales and a number of bins for keeping the different kinds of iron entering into the charges separate. There is no back wall to the charging platform. A 10-ton Pawling & Harnischfeger crane with a 70-foot span hoists the charges from the stockyard shown in Fig. 16 to the charging platform, using a 62-inch magnet. This crane is also used for unloading cars and piling iron in the yard.

Another Charging Floor

A second charging floor has been built 12 feet above the first expressly for charging sprues and domestic scrap. All the sprues, gates, etc., are brought down the north gangway by electric trucks, weighed on a Howe platform scale and taken on an elevator to the third floor. The elevator is also available for carrying charges to the main floor if anything should happen to the yard crane.

The floors of both charging platforms are made of steel plates attached with countersunk rivets to heavy I-beams and are capable of



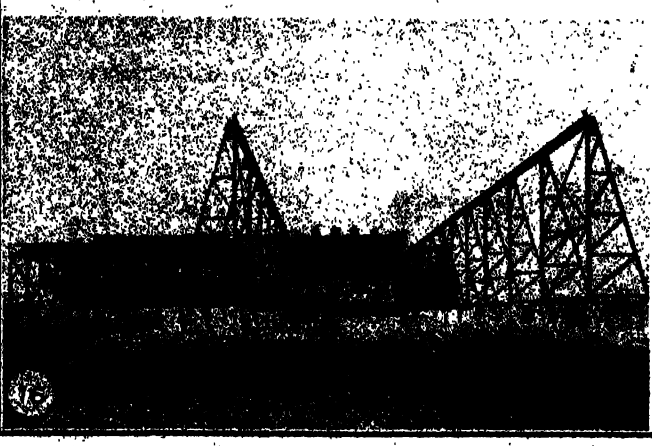


FIG. 13—UPPER FLOOR SET OF FACING-SAND MIXERS FIG. 14—CUPOLA BLOWER ROOM FIG. 15—STOCK BINS ON CHARGING FLOOR FIG. 16—CRANE RUNWAY OVER STOCK YARD FIG. 17—FRONT OF CUPOLAS FIG. 18—ARRANGEMENT OF BLAST PIPING AND CONTROL GATES FIG. 19—UPPER CHARGING FLOOR FIG. 20—PRELIMINARY CLEANING ROOM

supporting 2000 pounds per square foot. Adjacent to the charging floor a coke-storage room with a capacity of 1000 tons has been provided. The coke is discharged from the railroad cars on the outside of the building. A steel hopper provided with folding wings, which can be laid flat against the wall when not in use, guides the coke into the boot of an elevator, in which it is lifted and discharged on the floor of the storage room. This floor is on the same level with and connected to the charging platform.

A Preliminary Cleaning

The preliminary cleaning room shown in Fig. 20 is under the same roof but at the opposite end of the building from the cupolas. It is 164 feet 4 inches by 40 feet. The large cored castings, cylinders, etc., are cleaned in this room, using two sand-blast units supplied by the W. W. Sly Co., Cleveland. The cores are knocked out and the sand shoveled into hoppers in the floor, one of which is indicated at *G*, Fig. 20. A 30-inch belt driven by a 10-horsepower motor runs under the line of hoppers and carries the waste sand out through the hole in the north wall shown at *H*, Fig. 20, and delivers it into cars on an industrial track. These in turn are hauled to the dump where the sand is disposed of.

An illustration of the main cleaning room is shown in Fig. 21. It measures 281 feet 9 inches by 110 feet 6 inches. A perfectly smooth concrete floor facilitates the work of the electric trucks used for carrying the castings from one point to another. The mechanical cleaning equipment consists of one sand-blast unit supplied by the W. W. Sly Co., Cleveland, a large battery of 36 tumbling barrels built by the W. W. Sly Mfg. Co., Cleveland, and a battery of 12 double-wheel grinders made by the Norton Co., Worcester, Mass. The tumbling barrels are grouped back to back in batteries of 12; each group of six is belted to a common line shaft and driven by a 30-horsepower General Electric motor. The grinding wheels are shown in Fig. 23. The installation consists of 12 double-wheel stands carrying 4 x 24-inch wheels. They are driven from countershafts in groups of three and four by 15 and 20-horsepower motors. There is also a 4-foot surface grinder used principally for trueing the joints of the flasks used in the foundry.

The tumbling barrels and grinding wheels are attached to an elaborate dust-collecting apparatus. Individual pipes leading from each machine terminate in two large mains 36 and 42 inches in diameter respectively. These mains in turn find their outlet in one twin and two single dust arresters, each 40 feet in length and served by two Garden City double exhausters. Each of the exhaust fans is driven by an individual 100-horsepower motors made by the General Electric Co. Industrial tracks lead under the discharge pipes of the dust arrester and cars are supplied for hauling the refuse away.

The cleaning room is provided with the necessary apparatus for inspecting and testing the castings before they reach the shipping platform which is alongside the west wall of the cleaning room. The shipping department is served by a spur from the Pere Marquette railroad. Two scales are provided for checking the weight of the castings; one is a National counting scale and the other a Howe platform scale.

A supply of fuel oil is kept just west of the shipping platform in underground tanks of 10,000 gallons capacity each.

The pattern shop is a 2 story building 158 feet 10 inches by 100 feet. The lower floor is equipped with the necessary machinery for making and repairing patterns and the upper story is fitted up for a pattern storage.

The well being and comfort of the employes has been carefully considered and provided for. A building 280 feet by 80 feet 3 inches has been erected and equipped with an elaborate heating, toilet, bath and locker systems in one end; the remainder of this building is occupied by the cafeteria and foundry office.

Pittsburgh Foundrymen Start Meetings

Regular monthly meetings of the Pittsburgh Foundrymen's association for the 1919-20 season were inaugurated Sept. 15, at the Chatham hotel, with a paper by Enrique Touceda, consulting engineer, Albany, N. Y., whose subject was: "Some Pertinent Facts in Connection With Both Gray Iron and Malleable Castings." Mr. Touceda traced in interesting fashion the geology of iron, its early smelting and finally treated castings from a technical standpoint, the latter part of the talk being illustrated by lantern slides. A. M. Fulton, vice president of the Fort Pitt Malleable Iron Co., elected president of the association at its June meeting, presided, and announced the committees for the current year:

Officers and committees of the association follow: President, A. M. Fulton, Fort Pitt Malleable Iron Co., vice president, A. J. Hartman, United Engineering & Foundry Co.; treasurer, William J. Brant; secretary, Bayard Phillips, Phillips & McLaren Co.

Executive committee: C. S. Kogh, Fort Pitt Steel Casting Co.; Henry Spilker, Sterritt-Thomas Foundry Co.; J. S. McCormick, J. S. McCormick Co.; J. Lloyd Uhler, Union Steel Casting Co.; C. F. Williams, Allen S. Davidson Co.

Program committee: G. F. Tegan, *The Iron Trade Review*, chairman; H. M. Meixner, Pittsburgh Piping & Equipment Co.; J. W. Guay, Fort Pitt Steel Casting Co.; T. J. O'Brien, Fort Pitt Malleable Iron Co.

Entertainment committee, O. C. Dobson, Carborundum Co., chairman; C. W. Forcier, Mackintosh, Hemphhill & Co.; G. A. Bauman, Jones & Laughlin Steel Co.; C. L. Kirk, Kirk Supply Co.; L. W. Mesta, Mesta Machine Co.

Membership committee: L. A. Way, Lewis Foundry & Machine Co, chairman; John B. Coates, Pittsburgh Malleable Iron Co.; John Kahl, United Engineering & Foundry Co.; F. H. Clay, Allegheny Steel Co.; R. F. Eissler, Chicago Pneumatic Tool Co.; Thomas E. Reynolds, McConway & Torley Co.; Thomas Wilson, Rogers, Brown & Co

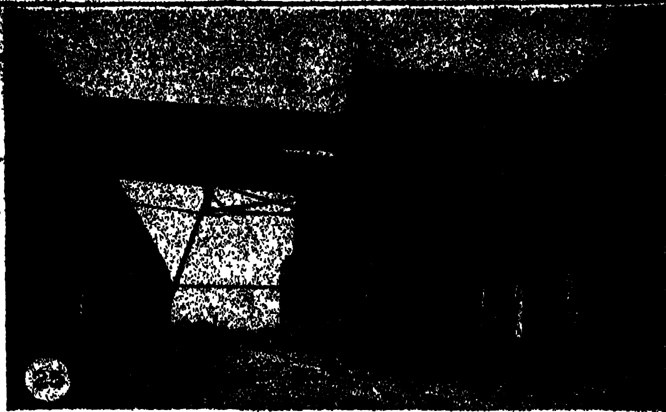
Chinese Tungsten Mines

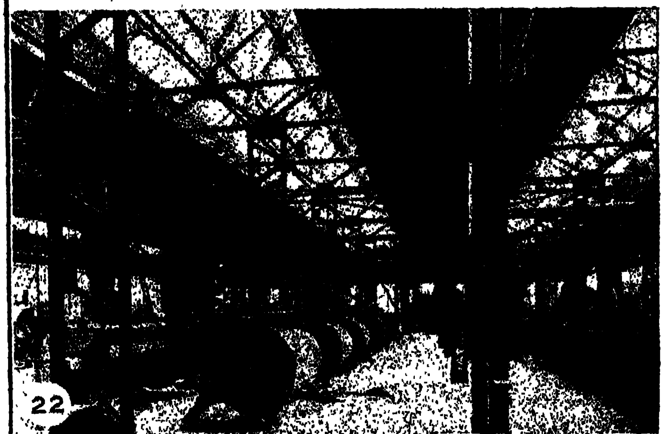
The American consul at Canton, China, in a recent report, describes a rapidly developing exportation of wolframite ore from several parts of China. When the trade in this ore began its value was not suspected by the natives, who sold it as iron ore to the Japanese at about 17 cents a pound. Now the average ore commands $32, gold, per 100 pounds at Canton. Much of it comes from Chengchow, Hunan province, and is carried on human shoulders a distance of 60 miles; then by junks 80 miles to Shiuchow; and the rest of the way to Canton by rail. Wolfram ore is said to occur at many places in Kwangtung province and also at places in Kwangsi province.

Instructions on Hoists

At a recent meeting of the Electric Hoist Manufacturers' association the engineering committee announced the preparation of a booklet entitled, "Facts for Operators of Electric Hoists." This publication is available through the secretary, W. C. Briggs, 30 Church street, New York.

The Wolff Mfg. Co. has acquired the business of the L. Wolff Mfg. Co. maker of plumbers supplies, and will extend its manufacturing facilities.





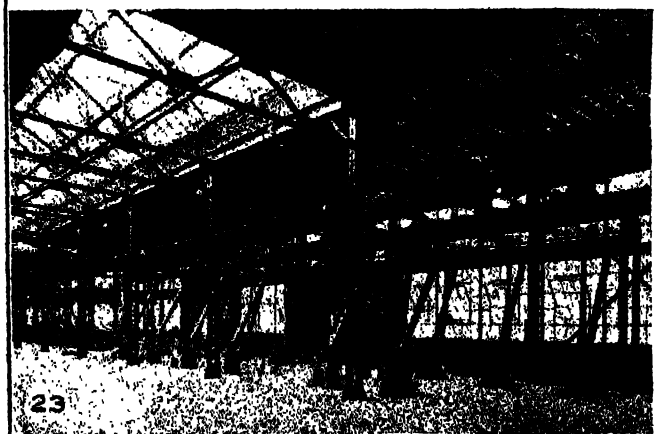


FIG. 21—GENERAL VIEW OF MAIN CLEANING ROOM FIG. 22—NOTE THE DIRECT OVERHEAD LIGHT ON THE TUMBLING BARRELS FIG. 23—THE GRINDING WHEELS ARE DRIVEN IN GROUPS OF THREE AND FOUR FIG. 24—MAIN PIPES FOR DUST ARRESTER FIG. 25—MAINS LEADING FROM THE CLEANING ROOM TO THE EXHAUSTERS FIG. 26—MOTORS AND FANS FOR DUST ARRESTERS FIG. 27—DEPRESSED TRACK AND CORE-SAND BINS FIG. 28—BOILER HOUSE AND COAL HOPPER

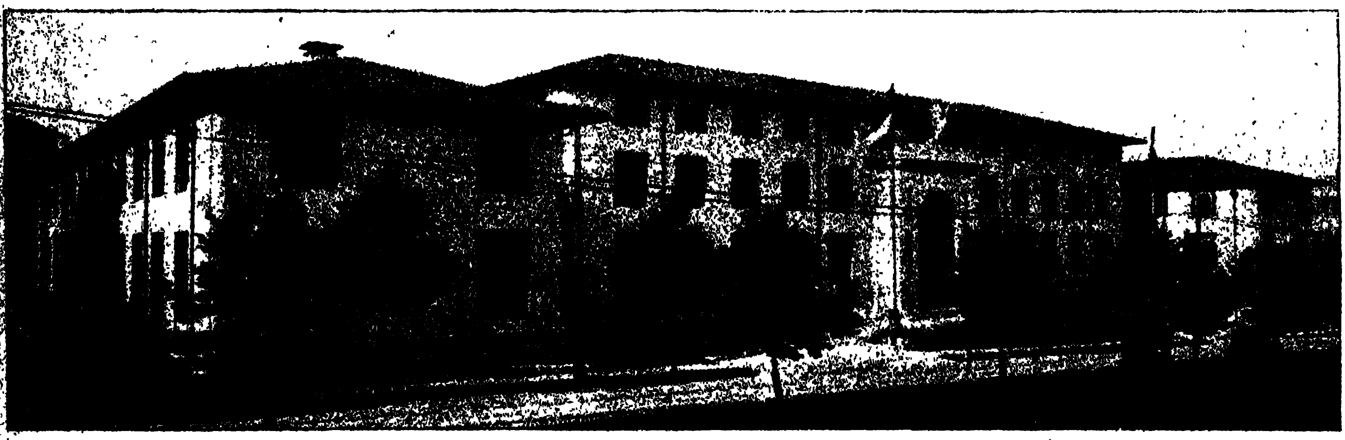
Bureau of Mines Laboratory Opened

Formal Dedication of the New Pittsburgh Experiment Station is Accompanied by Ceremonies Which Mark the Advance in Safety and Accident Prevention Work in Mining

MECHANICAL and mining engineers and those prominently interested in obtaining greater efficiency in the production and consumption of coal, took part in the dedication of the new million dollar laboratories of the United States bureau of mines in Pittsburgh, Sept. 29, 30 and Oct. 1. This laboratory represents the realization of a vision, the crystallization into stone and steel of the great concept of a great man who died before his work was done.

When the technical branch of the United States geological survey was organized in 1907 with Dr. Joseph Austin Holmes in charge the United States had the reputation of being where all kinds of accidents could be studied and methods developed for their prevention. He sought to establish a laboratory which operators and miners alike could feel was theirs and to which they could come for information and education. It was also his conception that this station should stop the waste in mining resulting from the inefficient methods employed and the excessive competition in the coal industry. To this end he foresaw the need of research laboratories for chemical and physical investigation of gases, explosives and mineral substances, the necessity of equipment for testing mine lamps and other machinery. Above all he knew that the work of the bureau would result president of the American Institute of Mining and Electrical Engineers; John L. Lewis, acting president of the United Mine Workers of America, and Hon. William C. Sproul, governor of Pennsylvania. At the conclusion of the addresses Secretary Lane formally delivered the keys of the building to Director Manning.

Luncheon followed at the bureau of mines building and then the guests proceeded to the experimental mine of the bureau of mines at Bruceton, Pa., 14 miles from Pittsburgh. Upon arrival there a prearranged explosion of coal dust occurred in the experimental mine as a demonstration for the benefit of the visitors. After the explosion there was an inspection of



NEW LABORATORY OF THE BUREAU OF MINES, PITTSBURGH, WHICH WAS FORMALLY DEDICATED SEPT. 29—RESEARCH WORK WILL BE CONFINED TO INVESTIGATION OF TYPICAL COALS AND NONFERROUS METALLURGY

not only the most prodigal nation in the expenditure of national resources, but of the lives of its citizens as well. Its leading place in the production of all the mineral substances was accompanied by a loss of life and health that resembled a vast war with the forces of nature. In 1907 there was an unusual number of mine explosions and the result was a general movement to prevent the needless loss of life. This movement culminated in the creation of the bureau of mines, for the purpose of promoting health, safety and efficiency in the mining industry.

Starting the work at Pittsburgh was a happy beginning, placing it in the center of so important a mining and metallurgical region. The bureau was housed at first in temporary and unsuitable quarters, but Dr. Holmes always kept in view a vision of a great experiment station for mining, in the training of thousands of miners in the use of rescue apparatus and in giving first aid to the injured.

The work at last is completed and the bureau of mines, in co-operation with the Pittsburgh chamber of commerce provided a program of events to fittingly commemorate the occasion. The ceremonies opened on Monday morning, Sept. 29, when the new laboratories 4800 Forbes street were thrown open for inspection. The dedicatory services were held at 10:30 a. m. on the lawn in the rear of the laboratories with Dr. Van H. Manning, director of the bureau, presiding. After invocation by Dr. S. B. McCormick, chancellor of the University of Pittsburgh an address of welcome was delivered by Hon. E. V. Babcock, mayor of Pittsburgh. Hon. Frank K. Lane, secretary of the interior, responded to the address and was followed by Horace B. Winchell, the mine and the explosive testing plant. The guests returned to the city at 6 p. m. A general meeting was held at Carnegie Music hall at 8 p. m. under the auspices of the Pittsburgh chamber of commerce.

The new laboratories were open for inspection the entire day on Tues. Sept. 30. The elimination contests in the national safety first aid and mine rescue meet were held at Forbes field during the afternoon. A demonstration of the explosibility of coal dust was given at Forbes field at 5 p. m., and in the evening the chamber of commerce presented a pageant typifying the spirit of the mining industry. The final mine rescue contests and other events, including a pageant in the evening, were held on Wednesday, Oct. 1. The pageant consisted of symbolical figures typifying the mother earth concealing her children, which are the minerals.

DATA ON BELTS AND PULLEYS

By W. L. Tryon

VELOCITIES OF BELTS OR PULLEYS

(Continued from Data Sheet No. 302)

Dia. of Pulley	Velocity of Belt or Pulley in Feet Per Minute when Number of Revolutions Per Minute Are 300	350	400	450	500	550	600	650	700	750	800	850
11	864	1008	1152	1296	1440	1584	1728	1872	2016	2160	2304	2443
2	157	183	209	236	262	288	314	341	366	393	419	447
2½	196	229	262	295	327	360	393	425	458	491	524	556
3	236	275	314	353	393	432	471	511	550	589	628	668
3½	275	321	367	413	458	504	550	596	642	687	733	779
4	314	366	418	471	523	575	627	680	732	784	836	889
4½	353	412	471	530	589	648	707	766	825	883	942	1001
5	393	458	524	589	655	720	785	851	916	982	1047	1113
5½	432	504	576	648	720	792	864	936	1008	1080	1152	1224
6	471	550	628	707	786	864	943	1021	1100	1178	1257	1335
6½	510	595	680	765	851	936	1021	1106	1191	1276	1361	1445
7	550	642	733	824	916	1008	1100	1191	1282	1374	1466	1557
7½	589	687	785	883	982	1080	1178	1276	1374	1472	1570	1669
8	628	732	838	942	1047	1152	1256	1370	1466	1571	1675	1780
8½	668	779	890	1001	1113	1214	1335	1446	1558	1669	1780	1891
9	707	825	942	1060	1178	1296	1414	1531	1649	1767	1885	2003
9½	746	875	995	1119	1244	1368	1492	1617	1741	1865	1990	2114
10	785	916	1047	1178	1309	1440	1571	1702	1833	1964	2094	2225
10½	825	962	1100	1237	1375	1512	1649	1787	1924	2062	2199	2337
11½	903	1054	1204	1355	1506	1656	1807	1957	2108	2258	2409	2559
12	942	1100	1256	1413	1571	1728	1885	2044	2199	2356	2513	2670
12½	982	1145	1309	1472	1636	1800	1963	2127	2290	2454	2618	2781
13	1022	1191	1362	1533	1703	1873	2044	2214	2384	2555	2725	2895
13½	1060	1237	1414	1590	1767	1944	2120	2297	2474	2651	2827	3004
14	1100	1282	1466	1649	1833	2016	2199	2382	2566	2749	2932	3115
14½	1139	1329	1518	1708	1898	2088	2278	2467	2657	2847	3037	3227
15	1178	1374	1571	1767	1964	2159	2356	2553	2749	2945	3142	3337
15½	1217	1420	1623	1826	2029	2233	2435	2638	2841	3044	3246	3449
16	1256	1466	1675	1885	2094	2303	2513	2722	2932	3142	3350	3560
16½	1296	1512	1728	1944	2160	2376	2591	2807	3023	3239	3455	3671
17	1335	1558	1780	2003	2226	2448	2671	2893	3116	3338	3561	3783
17½	1374	1603	1832	2061	2291	2520	2749	2978	3207	3436	3665	3894
18	1414	1649	1885	2120	2356	2592	2827	3063	3298	3534	3770	4005
18½	1453	1695	1937	2179	2422	2664	2906	3148	3390	3632	3874	4116
19	1492	1741	1990	2238	2487	2736	2984	3233	3482	3741	2979	4228
19½	1532	1787	2042	2297	2553	2808	3063	3318	3774	3829	4084	4339
20	1571	1833	2094	2356	2618	2880	3142	3403	3665	3927	4189	4451
21	1649	1924	2199	2474	2749	3021	3299	3574	3849	4123	4398	4673
22	1728	2016	2304	2592	2880	3168	3455	3743	4031	4319	4607	4895
23	1806	2108	2408	2709	3011	3312	3613	2914	4215	4516	4817	5118

(Continued on Data Sheet No. 304)

DATA ON BELTS AND PULLEYS

By W. L. Tryon

VELOCITIES OF BELTS OR PULLEYS

(Continued from Data Sheet No. 303)

Dia. of Pulley	Velocity of Belt or Pulley in Feet Per Minute when Number of Revolutions Per Minute Are 300	350	400	450	500	550	600	650	700	750	800	850
24	1885	2199	2513	2827	3142	3456	3770	4084	4398	4712	5027	5341
25	1964	2290	2618	2945	3273	3600	3927	4254	4582	4909	5236	....
26	2042	2384	2723	3063	3404	3744	4084	4425	4765	5205	....	....
27	2120	2474	2827	3181	3534	3887	4241	4594	4948	5301	....	....
28	2199	2566	2932	3299	3665	4032	4398	4765	5131	....	....	....
29	2278	2657	3037	3416	3796	4176	4555	4935	5314	....	....	....
30	2356	2749	3142	3534	3927	4320	4712	5105	....	....	....	....
31	2435	2841	3246	3652	4058	4464	4870	5275	....	....	....	....
32	2513	2932	3351	3770	4189	4607	5026	....	....	....	....	....
33	2592	3023	3456	3887	4320	4751	5184	....	....	....	....	....
34	2670	3116	3560	4005	4451	4896	....	....	....	....	....	....
35	2749	3207	3665	4123	4582	5040	....	....	....	....	....	....
36	2828	3298	3770	4241	4713	5184	....	....	....	....	....	....

Dia. of Pulley	Velocity of Belt or Pulley in Feet Per Minute when Revolutions Per Minute Are 900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
2	471	524	576	628	681	733	785	838	890	943	993	1046
2½	589	655	720	785	851	916	981	1046	1112	1178	1244	1309
3	707	785	864	943	1021	1100	1178	1257	1335	1414	1492	1571
3½	825	916	1008	1100	1192	1283	1375	1467	1558	1650	1740	1832
4	941	1046	1151	1255	1359	1464	1568	1673	1777	1882	1989	2094
4½	1060	1178	1296	1414	1531	1649	1767	1885	2003	2120	2238	2356
5	1178	1309	1440	1571	1702	1833	1964	2094	2225	2356	2487	2618
5½	1296	1440	1584	1728	1872	2016	2160	2304	2448	2592	2736	2880
6	1414	1571	1728	1885	2042	2199	2357	2514	2671	2828	2984	3142
6½	1531	1702	1871	2042	2211	2381	2552	2722	2892	3062	3235	3406
7	1649	1832	2015	2198	2382	2564	2748	2931	3114	3298	3482	3665
7½	1777	1963	2159	2356	2552	2748	2945	3141	3337	3533	3731	3927
8	1885	2094	2303	2513	2722	2932	3142	3350	3560	3769	3979	4188
8½	2003	2225	2448	2670	2593	3115	3338	3561	3782	4005	4228	4451
9	2120	2356	2592	2827	3063	3298	3534	3770	4005	4241	4476	4712
9½	2238	2487	2735	2984	3233	3482	3731	3979	4228	4477	4725	4974
10	2356	2618	2880	3142	3403	3665	3927	4189	4451	4712	4974	5236

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Castings for Ship Construction—X

Method of Constructing Patterns and Coreboxes for Shaft Bracket for Small or Medium Vessels — The Two Arms and the Middle Table Piece are Constructed Together

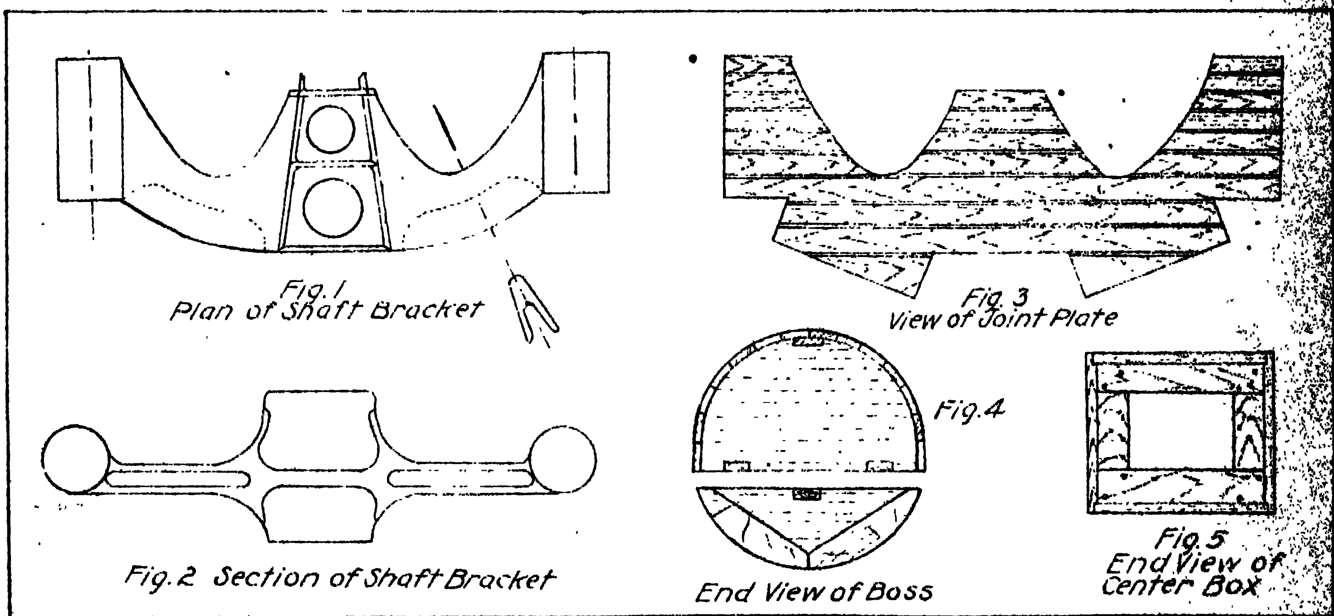
BY BEN SHAW AND JAMES EDGAR

THE shaft bracket shown in Figs. 1 and 2 is different in design from those already described. Instead of palms or flanges, the casting is usually supported by the stern frame casting and the shell plates. It will be noticed, also, that instead of two separate castings the bosses, the two arms, and the middle table piece all are one large casting. This is a form of bracket more common on small or medium size vessels. The design is equally applicable to large ships, but the casting is clumsy and difficult to make. If made for large work the center piece is split on the center line, each boss and arm being separate castings, bolted together.

The construction of the job differs materially from the palm type of bracket. It might be possible to make a skeleton pattern but this would not be profitable. It would take longer to build the curved ribs which enclose the center spaces, and which would have to be left loose, than it would to cut the large fillet on the outside from solid lumber and make coreboxes. It would also take longer to build the arms so that the molder could make a core from them, than it would to make them solid with a print and use a box. The relative quantity of lumber required in each method is important. There probably would be more timber used for a skeleton pattern, because much would be cut to waste and the coreboxes can be so made that little timber will be needed for them. However, more important than either the labor or lumber cost, is the quality of pattern produced by each method. Certainly, the solid pattern is preferred on this basis of comparison. In a skeleton pattern the heavy bosses would not be properly supported by the narrow arm end and there would be a grave danger of them breaking. Even if this did not occur the pattern might become warped in the sand with the consequent loss through an inaccurate casting. In this article, therefore the solid pattern and coreboxes will be considered.

The cores through the bosses are not shown in Figs. 1 and 2 because they are similar to those already explained, and the same methods of making the cores would be adopted. Several templates would be supplied for this job, for the arms, and also for defining the shape of the center, but the important template for the patternmaker would be that giving the contour of the bracket corresponding to Fig. 1. In all probability it would be the same as the drawing, but it might have been modified, and as usual, the pattern sizes would be taken from the templates. The large template is placed on a drawing board or on the floor and scribed around. The contraction then is added and it may be advisable to set down a section of the arm on top of this plan, and also one or two sections across the center table.

It is more convenient for the molder, if the pattern is made in two halves, the joint being through the center of the arms. It is essential that the whole pattern be built on joint plates. The patternmaker has to decide between three methods, a half lapped frame may be made, one thickness boards may be laid edge to edge and hardwood battens inset to bind them together, or a plate in two thicknesses may be built. The obvious disadvantage of the half-lapped frame is the difficulty of securing strength owing to the irregular shape. It is not possible to drive nails through from end to end. The two thickness plate is not commendable on the principle that it is bad prac-



FIGS. 1 AND 2—TWO VIEWS OF A DIFFERENT DESIGN OF SHAFT BRACKET FIG. 3 VIEW OF JOINT PLATE FOR SHAFT BRACKET FIG. 4—END VIEW OF BOSS FIG. 5—END VIEW OF CENTER BOX

tice as a rule to have side grain and end grain on one perpendicular, as the side grain shrinks and the result is unsightly and troublesome in the foundry. In the present case, however, strength is the important quality to be desired in the frame as on this factor depends the rigidity of the pattern. Fig. 3 is a sketch of this plate.

The lumber should be kept the full width of the boards and left with open joints. The illustration shows the face of the plate with the lumber running the full width. The other thickness would of course be screwed across. When the plates are both screwed they may be nailed together temporarily, dowelled, and the shape set out and cut. The main the small part can be planed from solid wood. If it is rather large for this the smaller end may be made as illustrated from end grounds, with pieces screwed to them, and a stay on the face. The lagged parts can be screwed through the plate, dogs being used to hold them while turning over, or the screwing can be done from beneath.

It would not be practical to construct the center piece and both arm fillets as one piece. It must be borne in mind that the deep side of the pattern is in the bottom of the mold, therefore the print has to be on this side. No cope print is needed, as the cores are steady without one, due to the large bearing which the circular holes in the center plate at joint plate. The print should be built separately. It should be noted that in the present design the angle of the arms is uniform from the end of the large fillet which connects them with the table center to the point where they join the boss. This leaves a piece of the joint plate uncovered forming what is equivalent to a rib to the face of the boss. More often, however, the angle is lengthened so that the shape of the arms is different along the entire length, in which case it would be practically impossible to do other than make them from solid lumber, joined edge to edge. Most of the segments in this case may be lightened before being built.

The arms built as shown in Figs. 7 and 8, consist of two grounds and

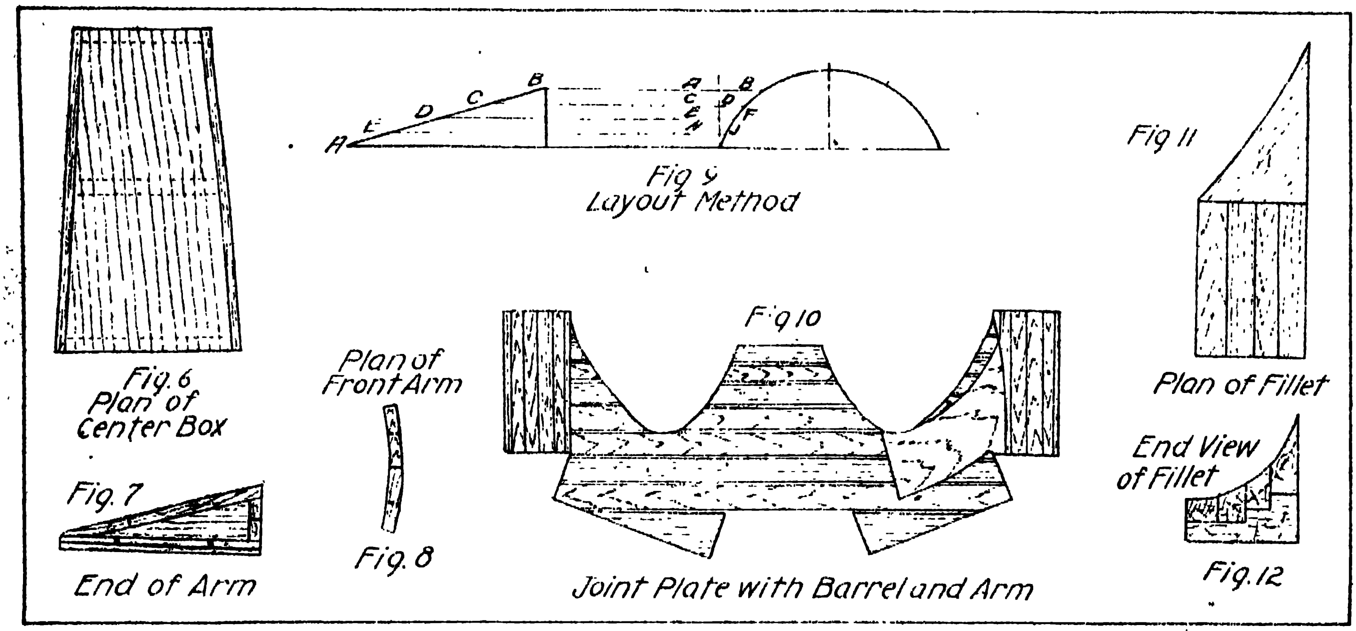


FIG. 6 PLAN OF CENTER BOX FIG. 7 END VIEW OF ARM FIG. 8 PLAN OF FRONT OF ARM FIG. 9—METHOD OF LAYING-OUT THE ARMS FIG. 10 JOINT PLATE WITH BARRELS AND ARM FIG. 11 PLAN OF FILLET FIG. 12—END VIEW OF FILLET

center line and the boss centers should be squared over on both sides of the plates. The parts of the plates A-A, Fig. 3, which support the prints should be wide to balance the cores. It will be necessary to trim off the ends of the plates, after the lagged barrel pieces have been screwed to the plates, because the centers of the bosses are not on the same plane as the pattern joint. If, however, the plate is made to the finished length, it is wise to make a large part of the barrel square from the center line as shown in Fig. 4, and the small portion full the size at the outside edge so that they can be trimmed. It may be possible for patternmakers to work so accurately that no trimming of edges is necessary, but it is safer to leave a little for final finishing. The large portion of barrel is made like an ordinary full barrel with checked stays and lagging, but ford. The best way to construct the center is to make a box similar to those shown in Figs. 5 and 6. This box is made the full width of the bracket in length, and across, it follows the inside of the line of metal. Thus the small portions of the cross ribs which are carried to the outside of the metal may be nailed or wired on afterwards so that the molder can leave this in the sand until after he has drawn the main pattern.

The grounds for the box may be half-lapped frames about 2 x 4 inches, nailed together. Fig. 5 illustrates this construction. Similar boxes are necessary for both the top and bottom.

If the work is small the blocks for the arms may be made from solid wood or from thicknesses glued together. However, if the parts are large, they should be constructed similarly to those shown in Fig. 7, where a block is shown set upon the a circular segment portion on which a top plate or plates are screwed. The top plate projects a considerable distance beyond the ground at the barrel end, and the fitting shape should be cut so that when the arm blocks are laid on the joint plates, no chalking and fitting will be necessary. This is a matter of simple geometry. Two views as shown in Fig. 9 are laid out on the drawing board. The line *AB*, Fig. 9, corresponds to the angle of the arm joining the barrel. Three or four lines are projected to the front elevation and the distances *AB*, *CD*, *EF* and *HI* are determined. Fig. 10 is a plan showing both barrels and one of the arms fixed on the joint plate.

Making the fillets is difficult. If large, they are built as shown in Figs. 11 and 12, and if smaller they are glued up solid as shown at *A*, Fig. 13. With either method the blocks should be fit-

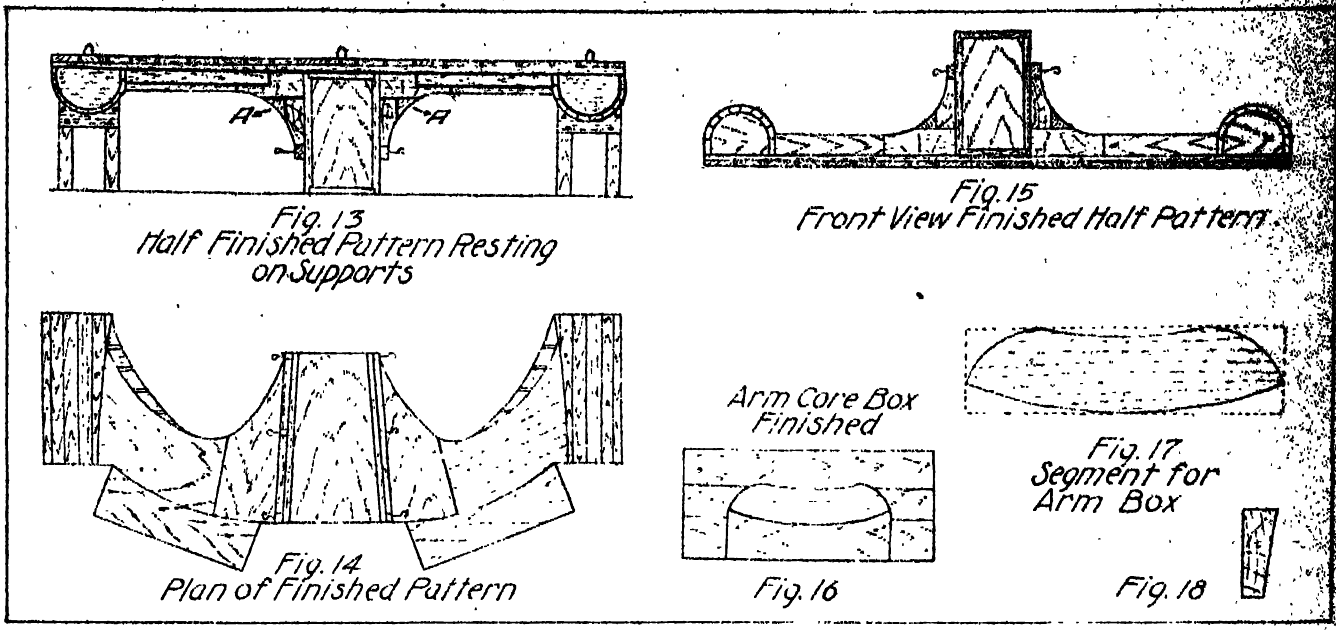


FIG. 13—FINISHED HALF PATTERN, SHOWING THE SUPPORTS FOR THE BARRELS FIG. 14 PLAN OF FINISHED PATTERN FIG. 15 FRONT VIEW OF FINISHED PATTERN FIG. 16—FINISHED ARM COREBOX FIGS. 17 AND 18 TWO VIEWS OF SEGMENT FOR ARM BOX

ted into correct position before they are cut to shape, when lines can be drawn off the arms. It is not possible, of course, to build that part of the fillet beyond the arm proper which is shown in Fig. 11.

The ribs that project beyond the ends of the center box are best left until the two halves are together to ensure their being in line top and bottom. The prints for the arms are made solid or boxed up according to the thickness. As a general rule when work is less than three inches thick, it is well to box it up. If these prints are made in this way an inch plate will do for the top with a front of the same thickness and two thicker ends. It is always good practice to make the grounds much thicker than lagging or staves because they have to take screws and also because they must be more rigid and stable. The ends are checked into the sides, that is the sides are recessed to form a shoulder, which prevents the ends from being knocked in.

The pattern now is ready to turn upside down to build the other half on top. It is not essential to build the one half on top of the other, and if sufficient men are available the two halves may be made concurrently, as long as the joint plates are made together. It is always necessary, however, to try the two halves together before the pattern goes to the molder, so that faces can be tested with a straightedge. There is also less danger of details being forgotten when the whole work is seen together. Before the half pattern is turned over, however, supports must be provided to carry the barrels, as shown in Fig. 13. Accuracy is necessary for these supports as the joint plates must be kept straight while the second half is being built. If the pattern is built with a twist it is almost impossible to rectify it after it is finished. To safeguard against this when building such a large pattern the joint face of the completed portion should be sighted with parallel srtaightedges.

It is not necessary to say much

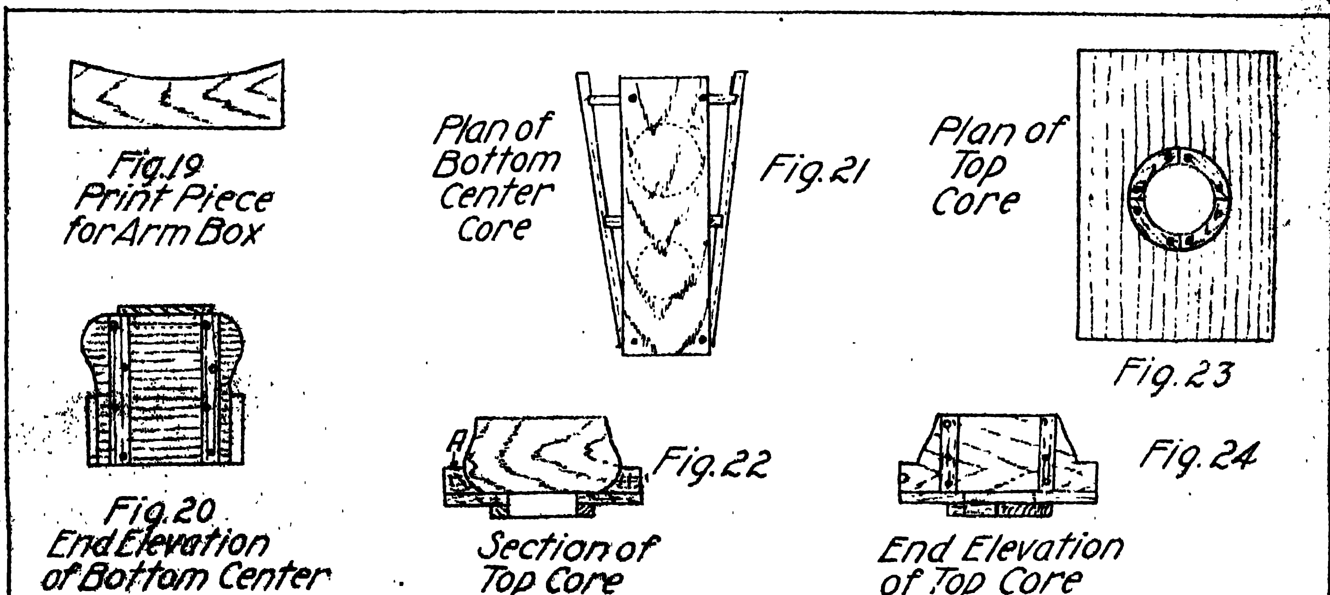


FIG. 19—PRINT PIECE FOR ARM BOX. FIG. 20—END ELEVATION OF BOTTOM CENTER CORE FIG. 21—PLAN OF BOTTOM CENTER CORE FIG. 22—SECTION OF TOP CORE FIG. 23—PLAN OF TOP COREBOX FIG. 24—END ELEVATION OF TOP COREBOX

about the second half as it is similar, although more shallow.

The center box for this half is made to the top of the ribs as no print is needed. The ribs at the end of the center table may now be screwed on. As it is possible that the molder will leave the ribs in the sand when he draws the pattern, no driving nails should be used to fasten them in place. Although they are not shown in the plan of the finished pattern, Fig. 14, or in the front elevation, Fig. 15, prints must of course be made for the ends of the barrels.

Identifying Marks

The central block in the shallow half of the pattern should be painted black or such a color as the prints are painted to signify that the core is on the outside. Much good time is wasted in the foundry measuring coreboxes to get thicknesses, which should be given by the patternmaker.

The easiest method for keeping the half pattern rigid while conveying it to the foundry, is to make two long bars about 3 x 9 inches in section, and screw them to the joint plates. In all probability the molder will leave them on the pattern while molding the bottom half.

The coreboxes are not difficult to make. They are four in number, one being necessary for the arm, and three for the table. A half box is all that is required for the arm core. Fig. 16 is a plan of this box. When the bottom plate has been made, a board at least ½ inch more than half the thickness of the print should be screwed to it, and cut to the counter of the core. If the box is made only for half the core depth, there will be a feather edge on the piece shown in Figs. 17 and 18. The taper of this piece should be planed while the timber is rectangular and the core shape afterwards drawn on it. A piece like Fig. 19, ½ inch thick completes the box. The two half cores are made and glued together in the foundry.

The table core should be made in three boxes. If it were made as one core, it would be difficult to make and would be too fragile to handle. It is really simpler to make the portions of the core above and below the middle plate separately, connecting them by a socket joint formed by placing prints in the bottom corebox, projecting circular cores being made in the top boxes. The whole of the bottom core, the core that is with the main print is undivided, but the top core must be in two parts as there is no print and a middle dividing rib must be provided. The two cores might be made in one box, but it is inconvenient in the foundry, and the small amount of extra labor involved in the patternshop, making two boxes, is well worth while. Figs. 20 to 24 give the different details in the construction of the top and bottom boxes. Boxes are not always so made in the patternshop that the molder can use his lifter without trouble. The most suitable grids also seldom are considered but they should be, and these boxes are designed with this object in view. The one style of box is as cheap as the other.

The bottom box consists of two sides and two ends, the ends being let into the sides. The sides are carried up to the beginning of the curve. It is not necessary to have a bottom on this box.

On the top and resting on the ends is a bar to carry the print. This bar should be dowelled so that it can be replaced without trouble. There is a little more work involved in making the other boxes. Bottoms are necessary and the circular holes have to be cut through these bottoms. The rings of segments on the underside of the plates are provided to save timber and make the boxes lighter. Blocks (*A*, Fig. 22) must be made and screwed to the bottom. These make the core to the center of the radius, and beyond this can be struck off in the same way. The ends of the box (*B*, Fig. 24) are made sufficiently long to enable them to be screwed to the ends. In all these boxes it is advisable to batten the ends, and it may be necessary to fit brackets against them to prevent them from being rammed outward.

Selecting Sands for Cores

Question—We would like to obtain a list of core sand mixtures covering all kinds of mixtures and for all thicknesses of metals.

Answer—It is not necessary to have such a list of core mixtures as mentioned in the query as it would lead to a lot of changing of sands and binders. When the reasons for using different sands is known it is always easy to make up mixtures to suit the class of castings being made. Two kinds of sands are used in core making; sharp sand and molding sand. The sharp sand carries off the gases better than molding sand as the latter contains alumina, is finer in grain and packs closer. More molding sand is used in the mixture for small cores because the castings must be smoother and, being small, little gas is generated. For this reason the molding sand is satisfactory as far as carrying off gas goes, and as it packs closer there are fewer openings between the grains into which the metal could flow and produce roughness on the surface of the castings.

Molding sand also forms an important constituent of cores that are made in the round, because, unless dryers are used, such cores must be handled green in transferring them from the core box to the core plate. They must, therefore, be strong before drying, and molding sand is an important factor in giving the sand strength. The binder also figures in the strength of cores made in the round. A binder which is soluble in water makes a stronger green-sand core than an insoluble binder; thus oil makes a weak core before being baked. Knowing these facts it is not difficult to select a sand mixture and binder suitable for the kind of castings specialized in. A mixture which would be perfectly satisfactory for light cores would be useless for heavy ones.

A foundry making small castings, the cores for which are mainly made in the round should select a core mixture containing considerable molding sand and a dextrine binder. If the cores are small and thin, but have to be very strong when dried, such as cores for trolley and splicer cars for overhead electric railroad work, oil is the best binder to use. There will be no difficulty about getting the cores out of the boxes and standing them on the plates, provided plenty of molding sand is used in the mixture.

For a heavy casting more sharp sand must be used. In some cases no molding sand may be mixed with it. To prevent the metal from entering the structure of the core, it must be protected by a coating of some infusible substance, such as plumbago, and the heavier the casting due to thickness of wall, the thicker must be the coating of plumbago. In some cases it is necessary to rub the coating onto the core with the fingers.

The amounts of sharp sand and molding sand in a core mixture will vary from all sharp sand to a mixture of 3 parts molding sand to 1 part sharp sand. For medium work use 1 part sharp sand to 2 parts molding sand. These are usually made up by taking 1-3 old molding sand; 1-3 new molding sand and 1-3 sharp sand, mixing and adding the binder. In the case of oil binder, use about 1 part oil to 32 parts mixed sand; flour 1 part to 10 of sand; gluten 1 part to 35 of sand; dextrine 1 part to 25 parts sand.

The Acme Silica Co., Ottawa, Ill., has opened new silica deposits at Sheridan, Ill., under direction of E. I. Larsen, general manager.

Using a Corebox Machine on Shallow Work

By William Ballantine

Notwithstanding the acknowledged efficiency of the machine which has been developed for shaping the interior of coreboxes, it is surprising to find that very few pattern shops have yet installed one as part of their regular equipment. It is still more surprising to observe the attitude of many patternmakers toward it. They seem to think it is something mysterious and therefore infinitely more dangerous on that account than any other machine used in the pattern shop. Furthermore there seems to be an impression that an expert is needed to operate it.

In the writer's opinion these views are entirely misleading. It is not as dangerous a machine to operate as a rip saw, and instead of an expert, an apprentice with very little instruction can turn out successfully the most difficult coreboxes. The machine not only makes a more perfect corebox than could be turned out by any patternmaker, but it does it in about 7 per cent of the time. For instance it will cut out a corebox in 20 minutes that would engage a patternmaker half a day if he had to gouge it out by hand.

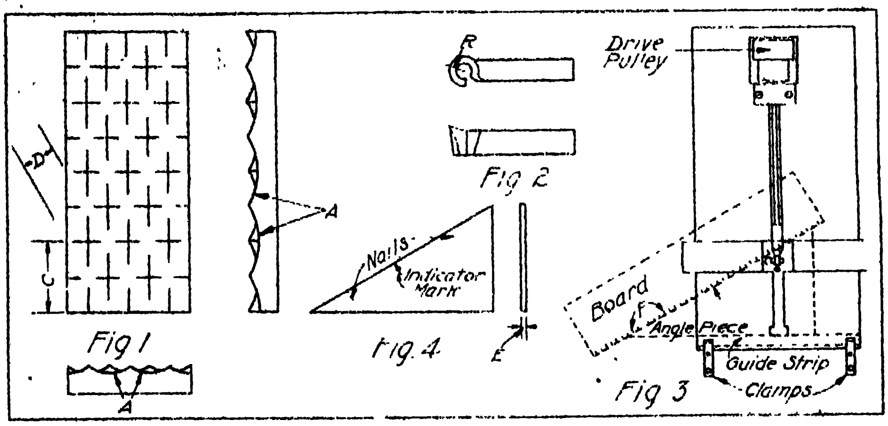
The following description shows a departure from the orthodox method of using the machine and proves how adaptable it is for making a style of pattern which is fairly common in all jobbing foundries.

Some time ago we were called upon to supply a rush order of diamond plate door stills. Not having time to send to the factory for stock diamond plate it was up to us to make it. The corebox machine was suggested by the patternmaker to whom the job had been given. We tried out the suggestion and to our surprise we got a better plate than we had ever obtained by hand.

Fig. 1 shows a top, end and side view of the plate. It also shows that the bottoms of the grooves were rounded and the tops of the diamonds were quite sharp. This feature was appreciated in the foundry where the pattern molded perfectly. Fig. 2 is a detail view of the cutter used in making the grooves. The radius R is one-half the width of the groove. The first step was to lay out on a suitable piece of board the desired diamond, Fig. 1. This gave the angle for the jig or angle piece, Fig. 4. The jig was a piece of lumber about the same thickness as the board on which the diamonds were to be cut. It was used to hold the board at the proper angle while it was being pushed across the cutter in the direction indicated by the arrow in Fig. 3. Two nails were driven in the hypothenuse of the jig and were left projecting just far enough to keep the pattern from sliding during this operation.

A guide strip, shown in Fig. 3, was clamped across the top of the table at one end and served for a guide for the jig. The indicator marks were to show how far to move the pattern after each cut.

Fig. 3 is a view of the top of the corebox machine with the fence removed. In making diamond plate, the work is moved across the machine instead of lengthwise, as in making coreboxes. The dotted lines show the position of the guide strip, the angle piece and the pattern. The pattern was marked off on the edge F, Fig. 3, with dividers the same distance as C, Fig. 1. The board was moved one mark each time a cut was taken off. One mark was always kept at the indicator mark. After all the cuts were made one way across the board, the angle piece was reversed and the cuts taken the other way. Diamond plate made this way saved both time and money and the diamonds were all perfectly uniform in shape, size and depth.



SIMPLE AND EFFICIENT DEVICE FOR MAKING DIAMOND PLATES

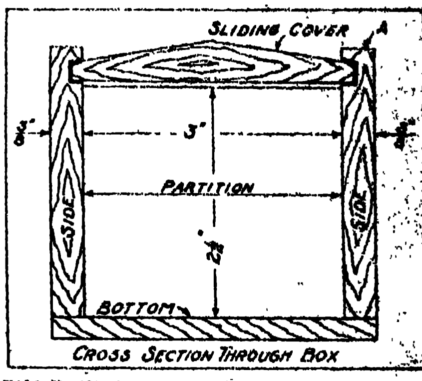
Order and System Save Patternmaker's Time

By M. E. Duggan

Brads, screws and nails are used every day in the construction of patterns. To use care in storing these supplies is considered by many patternmakers to be a waste of time. Nine times out of ten, however, those who scoff at order and arrangement are those who go every day to other departments or to fellow workmen to borrow set-screws or wire nails, because they cannot find those which they desire in their own disordered supplies.

The box which is shown in the accompanying illustration, I find to be most serviceable for holding brads or wire nails. The idea that "any old box" is good enough for nails is wrong. The careless patternmaker who has this idea is the one whose bench is a junk pile for all kinds of odds and ends. Belt lacing, leather fillets, wax, chalk, washers and jumbled packages of nails and screws litter the top and the drawers of his bench.

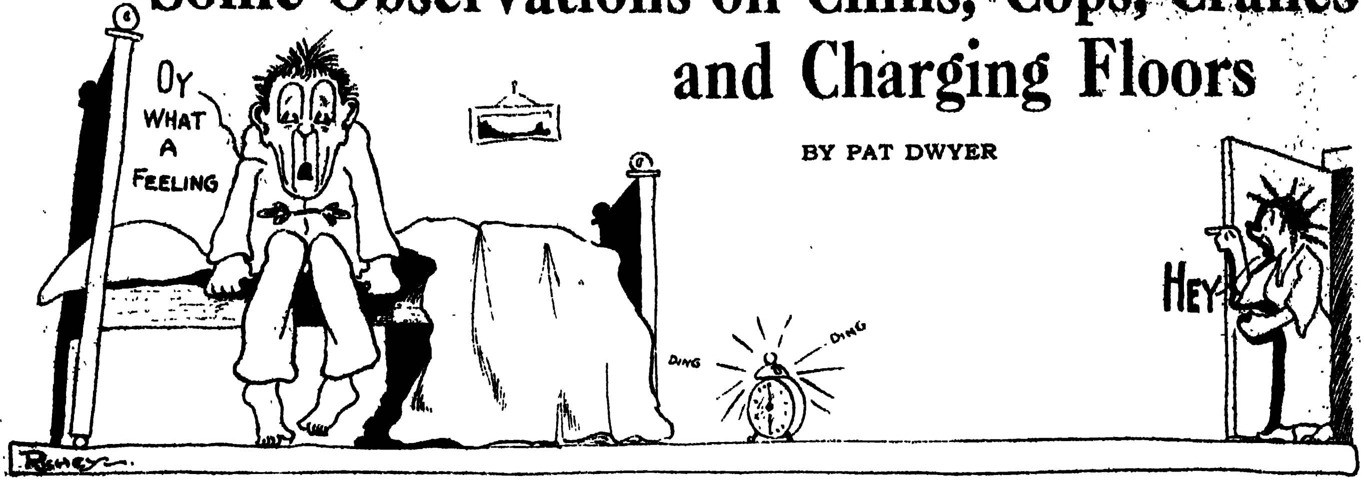
The box is 37 inches long, 3 inches wide and 2½ inches deep. It is partitioned into 12 compartments, each large enough to hold a pound of brads or wire nails. Each small box has an individual cover, except one box which is always open. In other words, there are 11 single slide covers. The size of the screws or brads contained in each box is marked on the top edge as indicated at A.



EASILY MADE SMALL BOX FOR NAILS, SMALL SCREWS AND BRADS

When a particular size nail or screw is wanted, the box edge indicates where it will be found. The covers then are slipped back together, allowing the one compartment to remain open, namely that which contains the size wanted. The others all are closed. If part of the nails or screws are not needed it is a very matter to drop them into the proper compartment.

Some Observations on Chills, Cops, Cranes and Charging Floors



BY PAT DWYER

ONE morning I awoke with a light head and a sore throat. I lay for a while debating whether I should get up or not. I had almost persuaded myself that a few minutes more or less would not make any difference when I commenced to sneeze. That settled the argument. A person can not sneeze comfortably in bed. If you lie on your face, you smother, and if you lie on your back, you need an umbrella. Then, too, the baby slept in a crib alongside and I was afraid I would wake her and believe me that is something else altogether.

I crept softly out of bed and putting on just enough clothes to get by the censor, I retired to the bath room to shave and sneeze as much as I pleased. I soon found that, like every other form of pleasure which is free, a little goes a long way. I finished shaving and dressing and went down stairs but found that I could eat no breakfast. My stomach felt as if it was closed for repairs, if you know what I mean, and I felt no interest in the date of reopening.

The lady who smiles at me (sometimes) across the breakfast table is a firm believer in the theory that as long as a man is able to eat he can be sent out to work; but if he cannot eat, then there is the gravest cause for alarm. "I think you had better stay home today," said she. "I will send for Dr. Squills, he will give you something to fix you up, and besides there are a few little things I want you to do around the house.

"Woman," I said, "I will stay home and I will take some of Dr. Squills essence of bitterino but - I will do no work. Little I thought when I was courting a certain dimpled maid a few short years ago that she would develop into a hard hearted creature with no pity for a dying man."

She laughed at me. "I had more than dimples in those days," said she, "I had the most childlike faith and used to believe all you told me, but now—well I have never been to Missouri—but you have to show me just the same."

What could a man do with an argument like that? Nothing. That is what I did.

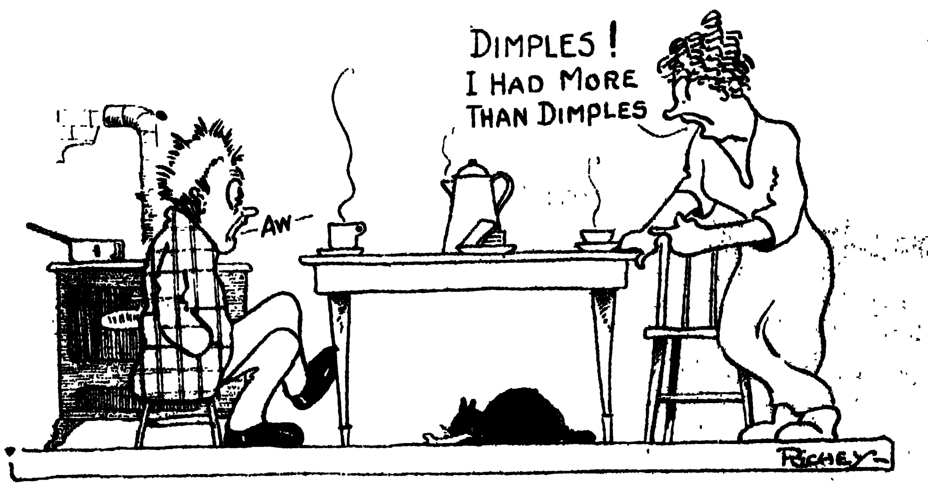
The doctor telephoned that he could not come up until the evening unless the case was very urgent. I told him I had the "flu" and if he let me die from neglect I would come back and sit on his bedpost at night and make faces at him.

"They never come back from where you are going," said he, "and besides I am never in bed at night." Then becoming serious he continued, "Do you know, I have not had a night's sleep in bed for weeks. But, I'll be out to see you this afternoon. I think from the sound of your voice that you will last that long."

I crept upstairs and into bed and for two weeks I did not care whether my name was on the payroll or not. The doctor called on several occasions and told my wife how nice she would look in widows weeds, told me that I needed to sweat a little more and I would be all right.

When I was a young man I had worked in some hot shops, I put in one summer season on the drydock in Farrel's and another closing cylinder molds in Baldwin's and I thought I knew what sweating meant. I found that perspiration and I were almost strangers. The doctor gave me a box of small tablets and whatever kind of googum was in them, they made me feel like a slice of watermelon in the hands of one of our colored fellow citizens.

I think R. Kipling must have had a flu victim in mind when he dashed off that description of the lady, you know the one I mean, "a rag, a bone and a hank of hair." That was all that was left of men when I finally got up one day and managed to get down stairs by hanging on to the balustrade. The doctor called in the afternoon and gave me the O-O and a cigarette. "Let me see you smoke that," said he, "and I can tell better what are your chances of an ultimate re-



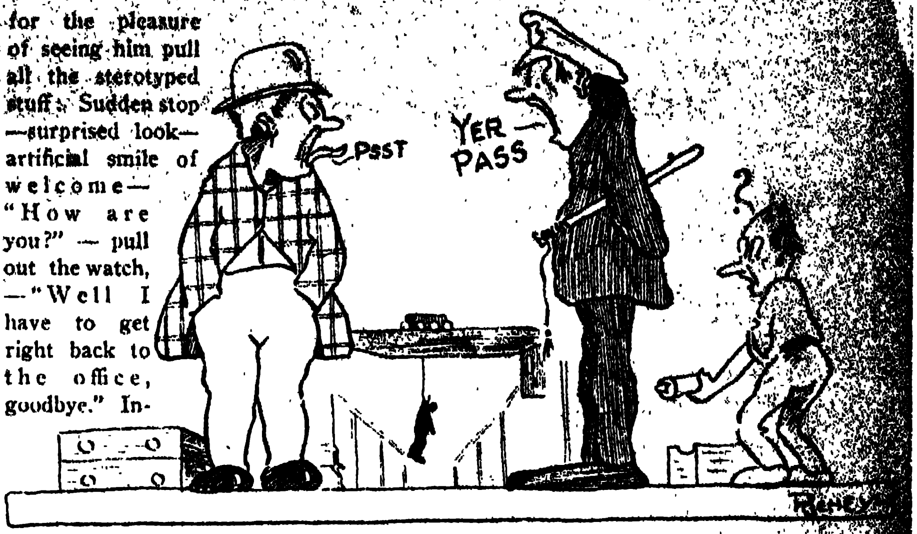
SHE DEVELOPED INTO A HARD HEARTED CREATURE

covery." I must have convinced him that I was going to stay on this little old earth for a while for he said he would have the druggist send me out a bottle of tonic. The bottle arrived the next day. It was strong medicine and before I had it finished I was certainly a new man, but bitter—I have spent many happy hours mentally revolving fiendish forms of torture which I would like to inflict on people that I do not like but that medicine suggested new and excruciating forms of which I had' never dreamed.

The members of the family keenly enjoyed watching the contortions when I swallowed the dose, but having arrived at the age of discretion they politicly tried to suppress any evidence of great pleasure. There was one exception, a young hero about four years old. Whenever he saw me reaching for the bottle he would attract everyones attention by yelling:

"Look quick, look quick, papa is going to make monkey faces and kick his foot on the floor." It was great fun for them while the bottle lasted.

One day while convalescing I walked down the street on which Bill's shop is located and finding the door open walked in. I did not see any sign of Bill so I strolled over near the cupolas to examine a feature of the charging floor which looked new to me. While standing there the manager passed me without a sign of recognition. He was one of our modern highly developed young captains of industry, curt speech--valuable time--look at his watch every other minute—you know all that modern bunk affected by some to impress the spectator that they are full of pep and energy, regular human dynamos. I know that it sounds rude to say that many of them are filled with prunes and piffle but truth is mighty and it is a pleasure to indulge in it once in a while. I had a speaking acquaintance with him outside the shop but of course it would never do for him to recognize me during business hours. Speaking to me might mean the loss to him of 60 of those diamond seconds. I had half a mind to flag him just for the pleasure of seeing him pull all the sterotyped stuff. Sudden stop—surprised look—artificial smile of welcome—"How are you?" — pull out the watch, —"Well I have to get right back to the office, goodbye." Instead, I politely turned my back and gazed right hard in the opposite direction until I thought he was safely out of sight. While thus musing on the peculiarities of some human beings I saw one of the guards approaching at a dead-and-alive pace. I knew the fellow, in fact he had worked for me one time, so I greeted him pleasantly. Did it have any effect on him? It did not. He was swinging his billy when he approached, he now tucked it under his left arm, held out his right hand and in that insolent tone which many acquire when they put on a uniform, he asked me if I had a pass. Just then I saw Bill approaching, I waited until he arrived and passed the case over to him.



THAT INSOLENT TONE OF UNIFORMED AUTHORITY

"Personal friend of mine," said Bill to the lad. "Beat it." "He can't stay in here without a pass!" protested Authority with a capital A.

"See here," said Bill, "We ain't livin' in darkest Russia, neither are we in a penitentiary; we are in a plain American shop in a plain American town and under these circumstances when a friend of mine comes in to see me he is going to stay, pass or no pass. On your way. I don't like the way you comb your hair."

"Those are the kind of fellows who make me turn bolshivicky," said Bill to me, "they have neither brains, ambition or energy and by their laziness, insolence and assumption of authority they create a feeling of hatred in the men not only for themselves but for the company which employs them.

"The system of issuing passes to visitors is right. It discourages indiscriminate visiting. If you had gone to the office and told them that you were a personal friend of mine they would have issued a pass to you and you could have come right in. The fact that I recognized you when you appeared without a pass would satisfy any person in authority but of course this bird with the single track mind could not see it that way."

"Perhaps I had better fly while the flying is fair and open," I said; "if that hill billy comes back it may get you in bad."

"Don't worry about me," said he, "the boss may be queer but he is not crazy. He is always willing to listen to an explanation and since he convinced himself some time ago that I tell the truth whether I am right or wrong he places considerable confidence in what I say."

"There is a nice point there," I said, "whether a man is justified in making an equivocal answer sometimes, but I am in no condition to put up an argument today. I just came in to see you and to notice whether you had made any improvements in the place since I was here before."

"I should like to draw your attention to one improvement," said he, "right there in front of the cupolas."

(Concluded on page 714)

THE HIBERNIAN COUPE BECOMES OBSOLETE

THE FOUNDRY

A semimonthly journal devoted to all branches of the foundry trade

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Contents

Tell Them About It

FIFTY thousand iron molders are on a strike in Great Britain. There is no question of collective bargaining, recognition of the union or anything of that sort at issue—these problems were settled long ago in the old country, presumably to the satisfaction of the workers. The chief subject of the present controversy is the question of payment by results, in other words the piecework system. The unions demand a uniform scale, applicable alike to the good workmen and the drones. The deadening effect of such a system of wage-paying on production is obvious. We may expect some such movement in this country before long. Today piece rates are scientifically adjusted, rigidly maintained and under modern conditions, payment by results is the only just system of rewarding workers. It insures the man with superior skill and industry being paid according to his deserts; also it tends to eliminate the inefficient and the shiftless. Furthermore, the piecerate system is a powerful stimulant to production—and greater production is the key to the solution of most of our economic troubles at the present time. Employers owe a duty to their men to teach them the fundamentals of business economics so they will understand why the cost of living cannot be reduced until more commodities are produced for general consumption.

Why a Tariff?

FOUNDRYMEN should interest themselves in legislation recently introduced in the house of representatives for the purpose of increasing the duty on Ceylon plumbago, graphite ores, imported crucible clays, etc. If these bills are passed, serious cost to the foundry business will result since inevitably prices on foundry facings, crucibles, etc., would be materially increased. Furthermore, business men and international bankers who take a broad view of affairs, are concerned over the great excess of exports over imports at the present time. The only way to remedy this situation is to encourage imports of materials calculated to benefit the industries of this country. It is estimated that fully 80 per cent of the graphite used for foundry facings is imported and up to date no deposits have been discovered in the United States equal in quality to the foreign variety. There is no opportunity, therefore, under the proposed tariff, to substitute an equally good domestic article. These facts apply to high grade crucible clays as well as graphite. Foundrymen who used crucibles during the war have a vivid recollection of the troubles they experienced, and the conditions which existed then constituted no reflection on the crucible manufacturers, who in fact achieved unusual results in the face of tremendous obstacles. Now, however, when the highways of foreign commerce are again open, it would seem that the placing of a tariff on these necessary foundry raw materials would result not only in injury to the foundry industry but to our entire fabric of international trade. Under modern tariff theories, most everyone is agreed finished goods may be protected to stimulate home manufacture, but raw materials, especially when they cannot be duplicated in the home country, should be entered free of all duty and restriction in order to further stimulate domestic industry and manufacture.

Trade Outlook in the Foundry Industry

THE first few days of the steel strike found foundries in general unaffected and confident that the situation will be righted before the foundry industry is seriously interfered with through the lack of raw materials. The very fact that the first few months of the year proved lean in orders has created a reserve of iron, and the past month's revival has brought a steady buying movement that finds most plants supplied for at least a month, while many have stocks which will carry them through until the first of the year. Gray-iron shops which handle jobbing work, within the past month have experienced such an increase that in many cases several months' supply of iron has been secured and stored within their own yards.

Malleable Fortified

Malleable plants all are supplied for at least 30 days, and all those which have facilities, have stocked pig iron heavily. Malleable operations have remained steadily at about 70 per cent of rated capacity, but the steady increase in demand finds many refusing orders due to the shortage in available labor. Iron, however, has been bought to supply the high percentage operation which has been expected, and therefore the supply on hand is more than ample to care for needs through the next few months. No direct effect on the price of foundry raw materials has been noted up to the present time. Inquiries, in many cases, have been held in abeyance by northern furnaces, pending more settled conditions, and in some northern districts so few furnaces supplying foundry iron are in blast that difficulty is experienced in placing orders. Indications of a buying movement in foundry iron which seems likely to approach the high level established in July are noted in the East. The offering of 1920 iron at the price range now in force is responsible for this rush of orders. The orders placed in the Boston district during the past week have ranged from a small tonnage to 4000 tons in a single contract. Stove foundries alone have taken over 1000 tons in this district and machine-tool and special machinery manufacturers are active inquirers. The strike does not seem to have affected the market in the East to an appreciable extent.

Prices Of Raw Materials for Foundry Use

CORRECTED TO SEPT. 25

Iron	
No. 2 Foundry, Valley	$26.75
No. 2 Southern, Birmingham	27.50
No. 2 Foundry, Chicago	26.75
No. 2 Foundry, Philadelphia	29.60 to 30.10
Basic, Valley	25.75
Malleable, Chicago	27.25
Malleable, Buffalo	27.25 to 29.00

Coke	
Connellsville foundry coke	6.00 to 6.50
Wise county foundry coke	7.00 to 7.50

Scrap	
Heavy melting steel, Valley	$19.50 to 20.00
Heavy melting steel, Pittsburgh	20.00 to 20.50
Heavy melting steel, Chicago	18.50 to 19.00
Stove plate, Chicago	23.50 to 24.00
No. 1 cast, Chicago	26.50 to 27.00
No. 1 cast, Philadelphia	24.50 to 25.50
No. 1 cast, Birmingham	24.00 to 25.00
Car wheels, iron, Pittsburgh	25.00 to 25.50
Car wheels, iron, Chicago	23.50 to 24.00
Railroad malleable, Chicago	19.50 to 20.00
Agricultural malleable, Chicago	20.00 to 20.50

Low Iron Production

Pig iron production in all grades, as shown by the figures of the American Iron and Steel Institute, suffered a slump during the first six months of 1919. The first half of 1918 and the last half of the same year both show greater production than does the first half of 1919. If the present rate of production is maintained throughout the remainder of the year, the total for 1919 will fall short of 1918 by 6,495,641 tons. This estimate was made before the strike introduced additional restraining influences.

The slump in blast furnace production during the first few months of the year is responsible to a large extent for the poor showing and the number of stacks blown in during July gave indication that unaffected by untoward circumstances, the last half year's would excell the first by a wide margin. Whether this will hold true will depend largely on labor conditions.

Pig iron production for the first six months by grades was as follows: Basic, 7,910,295 tons; bessemer and low phosphorus, 5,181,621 tons; foundry including ferrosilicon, 2,436,023 tons; malleable, 465,823 tons; forge or mill, 104,874 tons; ferromanganese, 106,056 tons, and spiegel, 38,136 tons. Merchant iron or iron made for the market totaled 4,499,133 tons, while iron made for the maker's use totaled 11,779,042 tons. It is noteworthy that the proportionate discrepancy between the first half 1919 production and the two six months' periods of 1918 is less marked in foundry grades than in the other classifications. This year fell behind the first half of 1918 by 182,698 tons, and lacked 190,513 tons of equalling the last half of last year. The corresponding comparison in both basic and bessemer grades shows this half year well over a million tons behind either half of last year. There was a deficiency in malleable iron production of 44,773 tons as compared with the last half of 1918 and 141,495 tons as compared with the first half of that year. As pig iron production invariably follows the demand, it is evident that with prosperity in foundry lines, these grades may closely approach the two six months periods of 1918.

Nonferrous Improves

The general upward trend in all lines of castings manufacture is particularly noticeable in nonferrous plants. The full return of automobile production has carried with it an increased demand for miscellaneous aluminum and alloy castings. The building revival has brought a great demand for hardware sundries, plumbing supplies and equipment for domestic use. A meeting of the Brass Manufacturers' association held in Detroit last week brought out the report that all brass casting plants have ample work, even beyond the limit of their labor facilities. This association is made up principally of those engaged in producing plumbing supplies. The prices of nonferrous metals have not yet been affected in any material way by the steel strike. Prices on brass foundry raw materials based on New York are: Copper, 21.50c; lead, 6.05c; tin, 54.75c; antimony, 8.50c; aluminum, No. 12 alloy, producers' price, 31.50c; and open market zinc is quoted at 7.00c, St. Louis.

Comings and Goings of Foundrymen

RALPH M. HILL, formerly with the Missouri Malleable Iron Co., East St. Louis, Ill., has been made president of the newly incorporated East St. Louis Casting Co. which will do jobbing work in light and medium gray-iron castings. John W. Eschenbrenner is secretary and Frank J. Kurrus is vice president of the new company.

W. J. Rowley has been placed in charge of the Huber Mfg. Co. foundry at Marion, O.

Fred E. Coughlin has accepted a position with the Laconia Car Co., Laconia, N. H.

John Blume formerly with the Holt Mfg. Co., Peoria, Ill., has been made assistant foundry superintendent for the Avery Co., Peoria.

Anthony Dobson has been placed in charge of a newly established branch office of the Carborundum Co., Niagara Falls, N. Y., at Detroit.

William Rohlman has resigned his position as foundry foreman for the Hoover Suction Sweeper Co., New Berlin, O.

Pierce G. Smith has been named vice president of the American Malleables Co., Lancaster, N. Y., and Owosso, Mich. Mr. Smith formerly was sales manager of the company.

H. E. McIntyre has been appointed general foreman of the new foundry of the Saginaw Products Co. division of the General Motors Corp., Saginaw, Mich.

L. E. Purnell recently has been made district manager at Cleveland for the Ajax Metal Co., Philadelphia. The new offices of the company are in the Schofield building, Cleveland.

Robert Field has resigned as foundry foreman for the Fairbanks Co., Rome, Ga., to become associated with the pig iron and coke department of that company in Cleveland.

W. J. Hughes has resigned as foundry superintendent for the H. & B. American Machine Co., Pawtucket, R. I., to take charge of the foundry of the Woonsocket Machine & Press Co., Woonsocket, R. I.

Frederick A. Stevenson formerly with the Detroit plant of the American Car & Foundry Co. has been made assistant vice president in charge of operations, with headquarters in New York.

A. A. Schneider has been assigned charge of the exports, imports and domestic sales of pig iron, manganese, chrome and other ferroalloys, coal and coke for the American Steel Export Co., New York.

William G. Hammerstrom, formerly general superintendent of the Lynchburg Foundry Co., Lynchburg, Va., has been made general superintendent for the Steel Castings Corp., Altavista, Va.

Alfred J. Saxe has been placed in charge of the branch office, established recently at 231 Insurance Exchange building, Chicago, by the Automatic Furnace Co., Dayton, O., manufacturer of automatic smokeless furnaces, chain grates, engines, etc.

Edward Smith, who formerly was foreman of the H. V. Newbigginy Pattern Works, St. Catherines, Ont., Canada, recently has accepted a position as foreman patternmaker for the Peerless Pattern Works, Buffalo, N. Y.

Joseph A. Hall has resigned as superintendent of the Tod-Booth plant of the United Engineering & Foundry Co., Youngstown, to become superintendent of the fireproofing department of the General Fireproofing Co. with headquarters and manufacturing plant in the same city.

William Turner, who comes to the United States from Canada, has been made superintendent of the foundry of the Ingersoll-Rand Co., at Phillipsburg, N. J. He succeeds Arthur Smith, who took his father's place as superintendent some time ago, but who resigned recently.

W. Edward Lindsay has been made engineer of the Lancaster Structural & Foundry Works, Lancaster, Pa., which recently purchased the plant of the Lancaster Machine & Structural Works of that city. Edgar G. Hess, formerly with the Lancaster Foundry Co. has been made works manager of the new company.

Charles P. Derleth has been made St. Louis representative for the Celite Products Co., New York City. About 14 months ago Mr. Derleth enlisted for chemical warfare service and prior to that was sales representative of the J. B. Ford Co., Wyandotte, Mich. He is a graduate of the University of Illinois.

E. Phelps Langworthy, formerly assistant works manager of the American Steel Foundry, Indiana Harbor, Ind., has been made manager of the steel castings plant of the American Radiator Co., Buffalo. G. W. Merrefield, formerly with the Clark Equipment Co., Buchanan, Mich., has been appointed assistant to Mr. Langworthy and will have charge of sales.

Auguste Griffoul who for the past few years has been foreman of the brass foundry department of Babcock & Wilcox Co., Barberton, O., has accepted a position as superintendent of foundries for the Flour City Ornamental Iron Co., Minneapolis. Mr. Griffoul's brother, Marcel Griffoul, has been made brass foundry foreman for the Babcock & Wilcox Co.

J. F. Shea recently has taken over the plant and equipment formerly owned by the Delta Foundry & Machine Corp. with which company he was employed as manager. A new partnership between Mr. Shea and his former foreman, Mr. Dixon, has been formed to operate the plant on nonferrous casting work under the name of the Marine Castings Co., 116 Fifty-seventh street, Brooklyn.

Society Will Establish Headquarters

The American Society for Testing Materials has taken steps to establish permanent headquarters in the building of the Engineers' club, 1315-17 Spruce street, Philadelphia. Temporary quarters were taken up on the first floor of this building on Sept. 13, pending completion of alterations now being made on the third floor where the society's permanent home will be established. The facilities will include an auditorium on the second floor, subject to the requirements of the society, and the committee rooms, and offices on the third floor.

Observations on Chills, Cops, Cranes, etc.

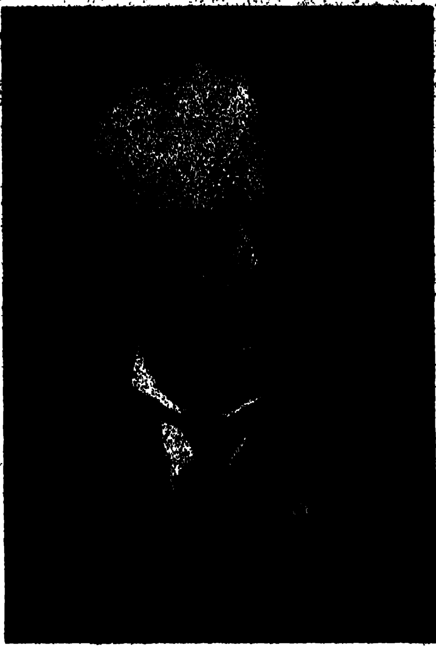
(*Concluded from page 711*)

We walked over and he explained to me that he had carried the entire length of the charging platform out into the shop for a distance of six feet. He kept his large ladles on each end of it and on the center he dumped the shop scrap. Every morning an iron box with one end open like those used in open-hearth steel plants was laid on the floor and all the scrap from the previous day's cast piled into it. When it was filled, one of the cranes picked it up and dumped it on the platform alongside the charging door. The box was then

returned, set on a truck and taken into the dog house. Here all the scrap, gates, etc., were gathered up in the same way and loaded into the box. The car was then pushed back to where the crane could catch the box which was lifted up to the platform and dumped as before. "It is quite an improvement," said Bill, "on the Irish locomotive we used to have, you know the one I mean one wheel in front and two starting bars behind."

Theodore O. Vilter

Theodore O. Vilter, president of the Vilter Mfg Co., Milwaukee, died Thursday night at his summer home on Pine lake, Wisconsin, aged 62 years He had been in failing health for several months. He was chairman of the general committee in charge of the meeting of the American Foundrymen's association at Milwaukee in 1918, and had served as president of the Milwaukee Metal Trades association and also of a Wisconsin association of ice machinery manufacturers. He was born Oct. 25, 1857, at Oldenburg, Germany, coming to America while a schoolboy. At 17 he began to earn his living as a blacksmith's helper, later serving an apprenticeship as a machinist and finally he became foreman in the shop of Peter Weisel where he started his apprenticeship. He was able a few years later to buy an interest in the company, which was known as the Weisel & Vilter Mfg. Co. In 1887 Mr. Vilter and his brother bought the interest held by Mr. Weisel, enlarging the business and changing the name to the Vilter Mfg. Co. The company specialized in refrigerating machinery and during the war marine engines were built in quantity for the Emergency Fleet corporation. Mr. Vilter was a director of the National Foundrymen's association and the National Metal Trades association and, in addition, held positions of trust in numerous Milwaukee industrial bodies.



THEODORE O. VILTER

The Damascus Bronze Co., Pittsburgh, has issued a trade publication under the title *Journal of Better Bearings*. The first number, dated August, 1919, is an attractive magazine of 10 pages. It describes the products of the Damascus Bronze Co., and in a lighter vein gives illustrations and reasons why high grade bronze should be used for bearings.

The Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill., is planning a car wheel foundry to produce 700 wheels per day. Neiler, Rich & Co., Manhattan building, Chicago, Ill., are the engineers in charge.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

An addition to its plant will be erected by the N. & S. Foundry Co., Seattle.

The Adler Stove & Range Co., Carnegie, Pa., has been acquired by the Keighley Mfg. Co.

The Champion Brass Works, Coldwater, Mich., has increased its capital from $20,000 to $75,000.

Erection of an addition is being planned by the Keeler Brass Works, Grand Rapids, Mich.

An addition is being erected at the plant of the Duriron Castings Co., Dayton, O.

The Union Steel Casting Co., Pittsburgh, will build a plant at 6100 Butler street.

Plans are being prepared for the erection of an addition, 100 x 250 feet, to the plant of the East Penn Foundry Co., Lehigh, Pa.

The Guerney Foundry Co., Ltd., Toronto, Ont., recently increased its capital from $750,000 to $2,000,000.

Erection of a foundry, 80 x 180 feet, is contemplated by the Pacific States Motor Truck Co., Seattle, which was recently incorporated.

The Monarch Foundry Co., Greenwood avenue and the Grand Trunk railroad, Detroit, will build a foundry, 100 x 200 feet.

A foundry, 66 x 120 feet, will be erected by the Eagle Foundry Co., Twenty-sixth street, Minneapolis.

Plans are being prepared for the erection of an addition to the plant of the Streh Castings Co., Detroit.

A branch foundry which was built a year ago by the Ameson Foundry Co., Kenosha, Wis., will be occupied in the future as the main plant, and an additional structure, 80 x 225 feet, will be erected.

The International Malleable Iron Co., Guelph, Ont., is having plans prepared for the erection of an addition to its plant, 120 x 190 feet.

The Birmingham Machine & Foundry Co., Birmingham, Ala., plans the erection of a plant addition.

The first cupola at the central foundry of the Saginaw Products Co., Saginaw, Mich., was tested out recently.

A contract has been let for the erection of an addition at the Saco Lowell Shops, Newton, Mass., to be 160 x 200 feet.

Plans for the construction of a foundry addition, 70 x 120 feet, are being prepared for the National Foundry Co., East Whitman, Mass.

Fire recently damaged the pattern shop of the Springfield Foundry Co., 3207 Smallman street, Pittsburgh.

Erection of a small addition, 35 x 60 feet, is contemplated by the National Bronze Foundry Co., Cleveland.

Contracts for the erection of a plant addition have been awarded by the Ensign Foundry Co., Toledo, O.

The directorate of the Wadsworth Foundry Co., Wadsworth, O., recently authorized an increase in capital from $15,000 to $100,000.

Paul Lemaitre, Ltd., Montreal, Que., has been incorporated to carry on the business of machinist and iron founder, with $90,000 capital, by Joseph Savage, Albert Sevigny and Emil A. Brodeur.

The Clarksville Foundry & Machine Shop, Clarksville, Tenn., is replacing a portion of its plant which was recently damaged by fire.

Gohmann Bros. & Kahler, New Albany, Ind., operating a stove foundry, are building an addition, 60 x 174 feet.

Fire recently damaged the plant of the General American Tank Corp., East Chicago, Ill., including the brass foundry, car and insulating shop.

The Malleable Iron Fittings Co., Branford, Conn., has started on the erection of an extension, 23 x 92 feet.

The Bond Foundry & Machine Co., Manheim, Pa., contemplates the erection of an addition, 25 x 150 feet.

Organization of a subsidiary company at Bath, Pa., is reported planned by the Penn Foundry & Machine Co., Allentown, Pa.

Contracts for the erection of a foundry have been let by the Montreal Locomotive Works, Ltd., 145 St. James street, Montreal, Que.

The gray iron foundry, which is under construction for the Thomas Davidson Mfg. Co., Montreal, Que., is nearing completion.

An increase in capital from $65,000 to $155,000 recently was made by the Atlas Brass Foundry Co., Columbus, O.

Two additions, 80 x 100 feet and 80 x 150 feet, will be erected at the plant of the Anderson Foundry & Machine Works, Anderson, Ind.

A movement is on foot to build a foundry at

Belvidere, N. J., for the manufacture of iron and brass castings. Oscar Smith, formerly of the Ingersoll-Rand Co., is at the head of the project.

The Iron City Foundry, Hamilton, O., is reported planning the erection of a plant addition.

Construction of an addition is under way at the plant of the Atlantic Foundry Co., Cleveland.

The Frost Mfg. Co., Kenosha, Wis., brass founder, will erect an addition to its foundry and build a new office building.

The Williams Foundry & Machine Co., Akron, O., recently awarded a contract for an addition, 60 x 145 feet.

An office building, 2-stories, 70 x 77 feet, will be erected at the plant of the Buffalo Foundry & Machine Co., Buffalo.

Erection of an addition to its machine shop and foundry is contemplated by the Slinger Foundry & Machine Co., Portage, Wis.

Bids will be taken shortly for the erection of plant additions by the Trenton Malleable Iron Works, Trenton, N. J.

The Moore Plow & Implement Co., Greenville, Mich., will build a foundry, 50 x 80 feet. F. P. Allen & Son, Grand Rapids, Mich., are engineers in charge.

The Woods Method Corp., Greenfield, Mass., has been incorporated to make castings, etc., with $99,000 capital, by Edward D. Woods, John L. Eppler and M. B. Markle.

The Gabrielson Mfg. Corp., Syracuse, N. Y., machine shop and foundry supplies, recently was incorporated with $50,000 active capital, by A. Meldrum, M. V. White and C. Gabrielson.

Plans are being prepared by Architect Henry Raeder, Chicago, for the erection of a foundry for the Maytag Co., 211 West Fourth street, Newton, Iowa.

Frank D. Chase, Inc., engineer, 645 North Michigan avenue, Chicago, is drawing plans for the erection of a foundry addition for the Ohio Steel Foundry, Lima, O.

Construction of an addition to its foundry will be started soon at the plant of the E. H. Bardes Range & Foundry Co., Cincinnati. The building will be 100 x 100 feet.

William J. Thiele, Herman J. Widmar and J. M. Eastman recently were named as the incorporators of the Cambria Car & Foundry Co., Fleetwood, Pa. The company is capitalized at $50,000.

Plans have been prepared for the erection of two buildings, one 80 x 80 feet and the other 40 x 50 feet, for the Sunray Stove Co., Delaware, O.

The Gleason Works, 1000 University avenue, Rochester, N. Y., has awarded a contract to A. Friederich & Sons, 710 Lake street, for the construction of a foundry.

The May Foundry Co., capitalized at $150,000, recently was incorporated in Delaware by F. R. Hansell, Philadelphia, J. Vernon Pimm and F. M. MacFarland, both of Camden, N. J.

Contracts have been awarded by the Union Motor Truck Co., Bay City, Mich., for the erection of a plant, 100 x 500 feet and a foundry, 60 x 120 feet.

The Coppus Engineering & Equipment Co., Worcester, Mass., manufacturer of turbines, pumps, etc., is reported contemplating the erection of a brass foundry.

A plant containing more than 120,000 square feet of floor space is being erected for the Adirondack Steel Foundries Corp., Colonie, N. Y. C. W. Sherman is president of the company.

Erection of a foundry, 43 x 120 feet, and a loading platform, 66 x 240 feet, is contemplated by the General Railway Signal Co., Lincoln Park, Rochester, N. Y.

The Pittsburgh Rolls Corp., Forty-third street, Pittsburgh, is reported planning the erection of a foundry and machine shop. The company is located at Forty-first and Willow streets.

The Holmes Foundry Co., Port Huron, Mich., will begin operations in its new plant about Oct. 1. Its old plant was damaged by fire about six months ago.

William E. A. Wheeler and associates of Washington, N. J., recently were named as the incorporators of the Ray Way Foundry, Inc. The company is capitalized at $200,000.

Plans have been completed for the erection of an addition to the plant of the Pittsburgh Valve, Foundry & Construction Co., Twenty-sixth street and the Allegheny Valley railroad, Pittsburgh.

The Peninsular Brass Works, Detroit, is building a new plant, which when completed will have about 150 per cent greater capacity than its present building. A. W. Fussey is president.

The Gilson Mfg. Co., Port Washington, Wis., has awarded contracts for a foundry and machine shop addition, 60 x 160 feet. The company specializes in castings for swivel chairs and furniture, but also manufactures gasoline engines, small tractors and other machinery. Harry W. Bolens is president.

Notice of incorporation with $250,000 capital, has been filed by the Continental Castings Corp., New York. The company was chartered by H. O. Bonner, F. E. Beidler and J. J. Flannery, 149 Broadway.

G. W. Johnson, former superintendent of the Chippewa Foundry & Machine Co., Chippewa Falls, Wis., is organizing a new corporation for the manufacture of engines. A plant is now being erected.

Syracuse, N. Y., interests have organized the Catliph-Knapp Pattern & Castings Co., Inc. The company, which is capitalized at $25,000, was incorporated by William H. Catliph John R. Sheldon, John Pickard and Charles E. Knapp.

Plans are being prepared for the erection of an addition, 105 x 120 feet, to the foundry of the Campbell Foundry Co., Harrison, N. J. When completed the building will be equipped with two cranes of five and ten tons capacity.

The Raymond Mfg. Co., New York, machine shop and foundry supplies, recently was incorporated with $150,000 capital, by H. O. Zorich, 5 Wilson court, M. Soken, 178 DeKalb avenue, Brooklyn, N. Y., and M. Cohen, 1226 Boston road.

The Lanham Cotton Cultivator Co., Empire building, Atlanta, Ga., will erect a plant to include, a machine and erecting shop, 50 x 120 feet, woodworking shop, shipping department, forge shop and foundry.

Plans have been completed for a plant for the Manufacturers' Foundry Co., Waterbury, Conn. The plant will consist of a foundry, 50 x 120 feet, a storage building, and a machine shop, 50 x 50 feet.

A recent incorporation is that of the Boyertown Brass Foundry Co., Boyertown, Pa. The company, which is capitalized at $50,000, was incorporated by W. M. Johnson, A. R. May and Garrett J. Hemes.

The Moline Iron Works, Moline, Ill., has purchased the Moline Three-I baseball park, which will be utilized as a site for a malleable foundry, 110 x 400 feet, and an enameling and finishing building, 110 x 360 feet. Construction contracts have been awarded.

According to a report the present plant of Sutton, Steele & Steele, Forney avenue, Dallas, Tex., will be greatly enlarged. The improvements will include an iron foundry. Walter L. Steele is president of the company, which was recently incorporated in Delaware with $1,000,000 capital.

Capitalized at $10,000 the East St. Louis Castings Co., East St. Louis, Ill., which was recently incorporated, has taken a lease on a building which it is now converting into a foundry for the production of medium sized gray iron castings. Practically all equipment has been purchased and the company expects to engage in active business the latter part of October. Ralph W. Hill is president.

New Trade Publications

REFRACTORY MATERIAL.—The Quigley Furnace Specialties Co., New York, has published an 8-page illustrated booklet in which a refractory plastic material for bonding fire brick and kindred uses, is described and illustrated. The booklet contains testimonials, illustrations, etc., pertaining to the use of this material in the foundry.

NONFERROUS METALS.—White & Bro., Inc., Philadelphia, have prepared a 24-page booklet pertaining to the manufacture of nonferrous metals. The latter part of the booklet is devoted to illustrations of various departments of the company's plant, and include, the laboratory, the electrolytic table, a corner of the balance room, the copper warehouse and test departments.

BLOWERS.—The Buckeye Blower Co., Columbus, O., has prepared bulletin No. 10, which describes and illustrates multi-blade fans for mechanical ventilation, forced or induced draft, mine ventilation, dry kiln where hot blast is used, waste heat installations of all kinds, mechanical systems where space is limited and exhausters. Various data are given. A chart for determining frictional resistance or static pressure in inches, water gage, is given.

SAND MIXER.—The National Engineering Co., Chicago, is circulating an 8-page booklet in which a sand mixer is described and illustrated. The mixer consists of a stationary circular pan in the center of which is located a vertical shaft, to which is keyed a central supporting casting or cross head. This casting rests on a turret in which are the bearings for the central shaft, which is operated by bevel gearing located below the machine. The supporting casting carries the plows and mullers. A lever operated door located in the bottom of the pan serves to discharge the sand from the mixer.

SWING CUT-OFF SAWS.—A 4-page illustrated circular is being distributed by the Oliver Machinery Co., Grand Rapids, Mich., in which swing cut-off saws are described and illustrated. The frames of these saws are supported by trunions which are independent of the countershafts. The frames are hung low from large screws which are supported in the hangers by means of hand wheels, permitting adjustment. The saw arbors are mounted in separate yokes which are removable from the frames and which are held in finished slots securely bolted. The arbor bearings are automatically lubricated.

BUILDING CONSTRUCTION.—A 40-page booklet designed to illustrate and explain the equipment used and the methods employed in the construction of modern buildings under a system developed by the Blaw-Knox Co., Pittsburgh, has been prepared by that company. The booklet is profusely illustrated.

TOOL GRINDER.—A 4-page leaflet has been prepared by Alfred Herbert, Ltd., Coventry, England and New York, in which an oscillating tool grinder is described and illustrated. In this grinder the grinding wheel oscillates rapidly past the tool, which is always in full view. Grinding is performed without water but a fan connected to a streamline duct in the base of the toolholder, draws all dust and chips away. The wheel spindle, self-contained countershaft, loose pulley and all shafts in the gear box with the exception of the eccentric shaft, run on oil-tight, dust-proof ball bearings.

POWDERED COAL.—The Combustion Economy Corp., Chicago, has published bulletin No. 2 in which the history and the possibilities of powdered coal as a fuel are described. Types of furnaces, draft, preparation of powdered coal for burning, storage, separation of scrap iron from coal, crushing, drying, distributing to furnaces, air supply, control, carburization and adaption to furnaces, are some of the points in the use of this fuel, which are given. A line drawing of a typical powdered coal burning system is also given.

THE FOUNDRY

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Seek Economy in Repetition Work

Molding Methods Are Studied Carefully With a View to Eliminating Machine Work—Iron is Cast Around Steel Bushings to Make Bearings—Chills Are Used Extensively

TO A large degree the design of every manufacturing plant is an individual problem. This fact prevents taking a previous design and adopting it bodily when building a new foundry. The situation, shape and size of the available location all exercise a modifying and many times a determining influence on the design. Other governing factors are the amount of the daily melt, the weight and variety of sizes of the castings and the proportion of cored work; whether a large number of patterns must be provided for only a few castings on an order or whether a large number of pieces will be made from the same pattern also are questions which must receive consideration in designing a foundry. Some of these questions can be decided before the foundry is built, but frequently some of the future requirements must be estmiated on rather indefinite data. It might seem at first thought that the design of a foundry doing repetition work is simple and this probably would be true if the production of castings was the only consideration and if no attention were paid to producing at minimum cost. Attaining efficiency and low cost of operation introduce complex and interest questions when a foundry is constructed for repetition work. An example of the influence of these factors on plant design is seen in the foundry of the Hurley Machine Co., Chicago, which was built recently. About two years ago this company, which previously purchased its castings from outside sources, decided to build its own foundry. The castings used are parts for electric washing machines, ironers and vacuum cleaners. None of them are heavy; the largest weighs about 100 pounds while many weigh less than an ounce. The machines are made in only a few standard types and this keeps down the number of patterns required. These standard designs are seldom changed. So that when a pattern is put into the foundry it may be used continually for a number of years. Many molders who began work with the company when the foundry was started early in 1918, are still working on the pattern which was given them at the start and some of them probably will continue to mold the same castings as long as they stay with the company. From the foregoing it may be seen that practically all the requirements for gaging the foundry output, except the amount of iron to be melted, were easily determined before this foundry was constructed. The impossibility of more than estimating

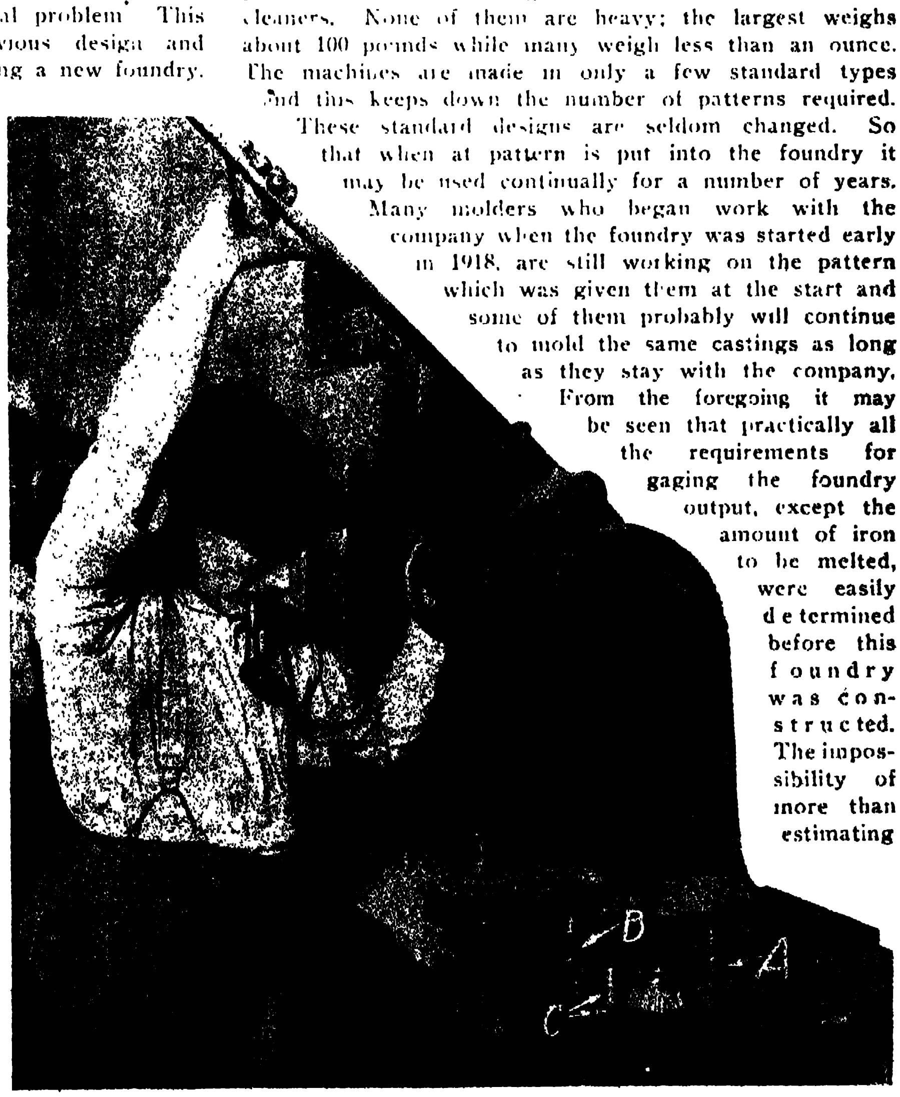

FIG. 1—PUSHING CHILL CORES OUT OF CLUTCH CASTINGS

the growth of the company's business prevented an accurate forecast of the weight of melt needed. When the foundry was started the casting requirements were only 6 tons a day. At the present time, a year and a half later, the entire capacity of the shop is being used, giving an output of 23½ tons daily.

The plan of the building is a truncated triangle. Back of the base of the triangle is the stockyard which is shown in Fig. 3. The wooden structure at the right in the foreground is used for sand storage and the frame building further on shelters the coke pile. A railroad siding running parallel with these buildings is located back of them. This arrangement allows cars to be placed conveniently for unloading. Pig iron is stored between the two buildings and on the far side of the coke-storage building. The foundry, not including the cleaning room, covers an area of approximately 23,500 square feet. About 12 per cent of this space is occupied by the cupola charging platform which is in the center of the base of the triangle and from which point a monitor roof extends along over the center of the shop On the two sides of the monitor, with the ridges running parallel to it, is a section of saw-toothed roof. The cleaning room and stock room are in the main building opposite the charging floor. Castings are sent from the cleaning room direct to the machine shop, which is in another section of the building but adjacent to that portion containing the stock room and cleaning room. One 48-inch cupola is at present in use. The charges weighing 2000 pounds are made up of 60 per cent pig iron and 40 per cent sprues and home scrap. Mixed with the home scrap is a small amount of galvanized work which apparently does not prove deleterious in the cupola.

The pig iron and scrap are loaded upon trucks, two of which are seen standing alongside the building in Fig. 3. These are loaded with iron and weighed to the correct amount on platform scales, hoisted to the charging platform in an elevator and held there until charged into the cupola. The coke is handled somewhat differently. It is brought from storage in wheelbarrows. Each load is weighed as it passes the scales to the elevator, but when it reaches the charging floor it is all dumped on one pile until enough for the day's heat has been accumulated. The amount of coke for the bed and for each charge is estimated by the number of forkfulls which are used. This method of handling the coke has proved satisfactory. The weight used for each heat is determined accurately and the amount

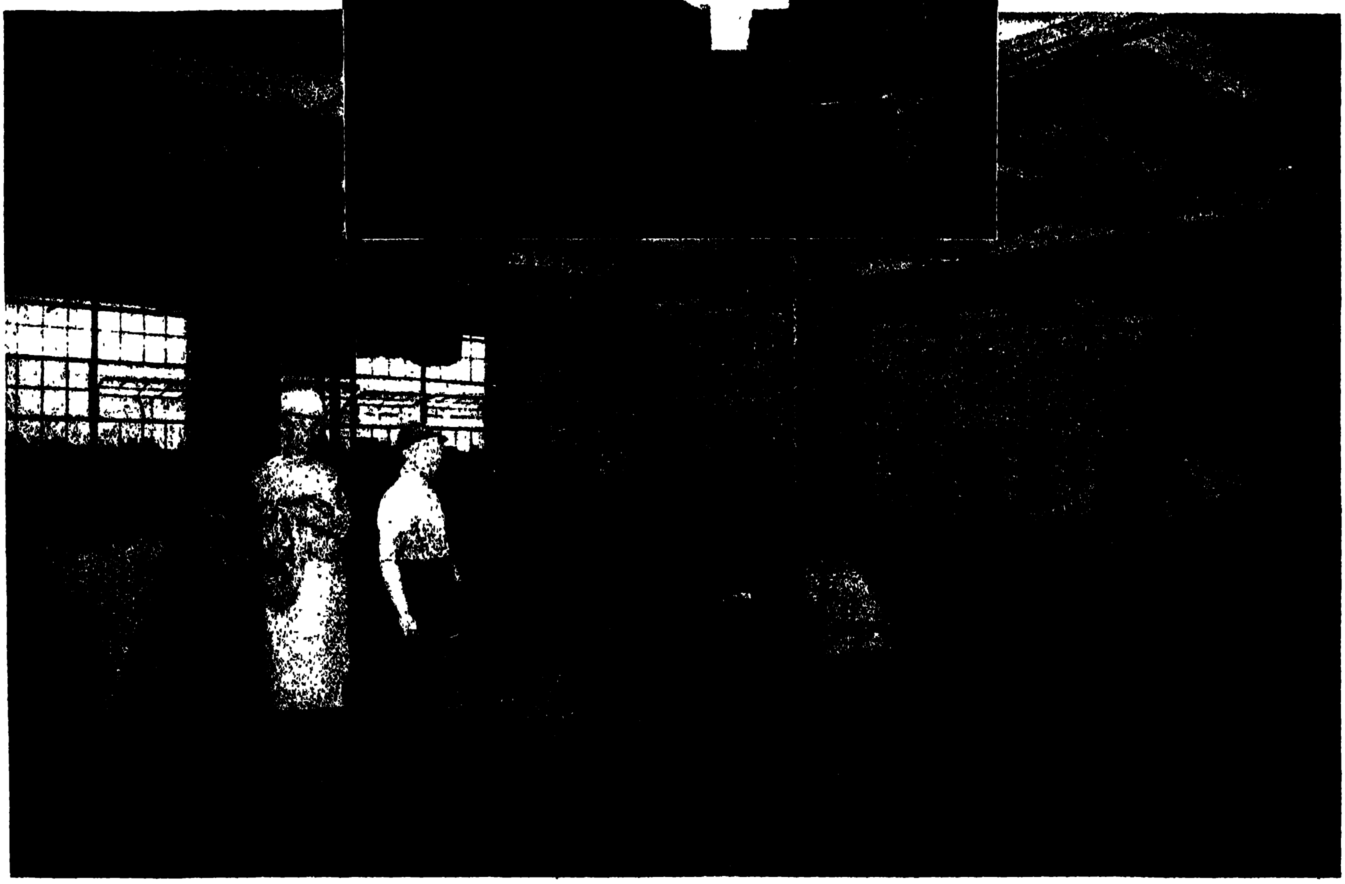

FIG. 2—CORNER OF THE FOUNDRY IN WHICH THE FLOOR WORK IS MOLDED FIG. 3—COKE AND SAND ARE STORED IN WOODEN BUILDINGS TO THE REAR OF THE FOUNDRY

on each charge is gaged so closely by the man charging the cupola that there is always enough left for the last charge without there being an excess.

A centrifugal blower manufactured by the General Electric Co., Schenectady, N. Y., furnishes the blast for the cupola. It is operated by a 30-horsepower motor at 3450 revolutions per minute. A blast pressure of 14½ ounces is used.

In order to save time for the cupola operator a convenient method has been devised for cooling the refuse from the drop. A long pipe is connected with the water line and swung under the center of the cupola after the bottom is dropped. At the end of this supply line another pipe about 12 inches long is attached vertically and at right angles. The short pipe is capped so that a fine spray is distributed over the mass of heated refuse when the device is swung into position under the cupola. While the refuse is cooling after dumping the bottom doors, the cupola tender may wash up or attend to other duties, turning off the water before leaving the foundry.

The composition of the metal is checked by having an analysis made three times a week by the Charles C. Kawin Co., Chicago. This company also acts in a consulting capacity and advises regarding charging and operating the cupola and on other metallurgical problems which arise. The following composition of metal is aimed at: Silicon, 2.50 per cent; sulphur, as low as possible, usually running between 0.08 and 0.09 per cent; phosphorus, between 0.70 and 0.80 per cent, and manganese, between 0.65 and 0.70 per cent.

When the metal comes from the cupola it is carried to the molding floors in 1500-pound buggy ladles from which it is delivered to hand ladles for pouring the molds. Two of the buggy ladles are shown in Fig. 2. They are tilted by a handwheel geared to the ladle trunnions. The narrow-gage tracks on which the ladle buggies run are laid in the shape of the letter H with the cupola facing one leg of the H. The ladles are transferred from one track to the other by transfer tables situated at each junction of the cross bar of the H.

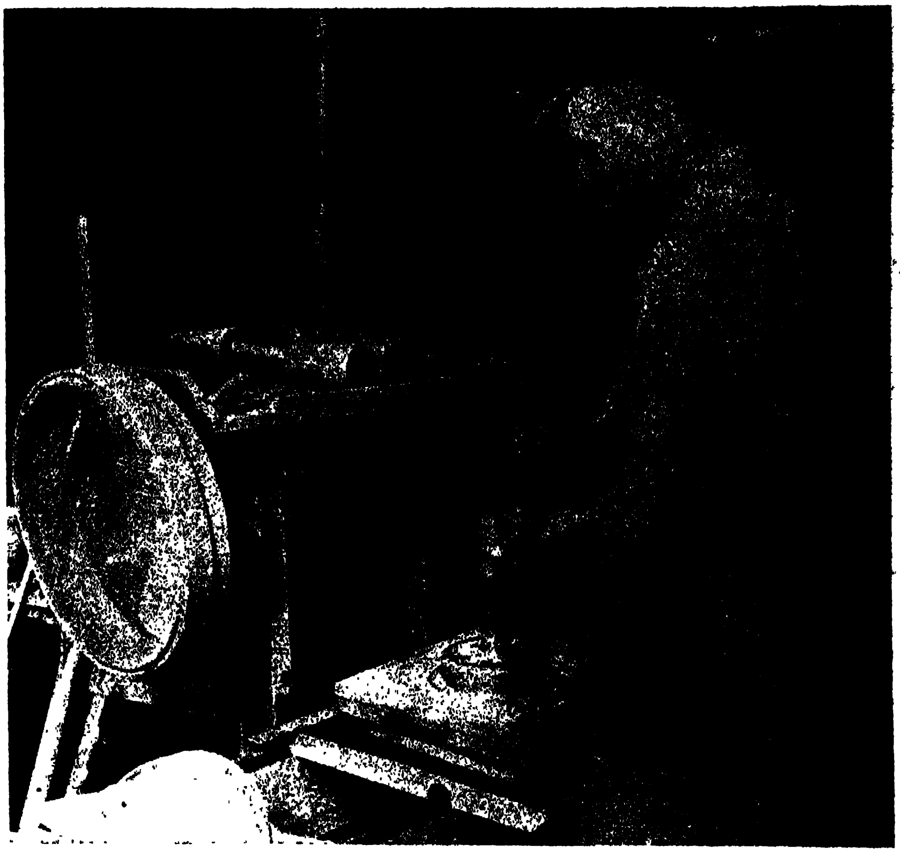

FIG. 5—A LOOSE PIECE IS USED ON THE PATTERN IN ORDER TO FACILITATE DRAWING

Business has increased so fast with the Hurley company that the existing capacity of the foundry is not sufficient to supply the castings required. This emergency was taken into consideration when the foundry was designed and provision was made for the installation of a second cupola to stand beside the one now in use. Another 48-inch cupola has been ordered and when it is erected a continuous pouring system will be inaugurated. This will conserve a large part of the floor space now required by the molds which accumulate before pouring begins in the afternoon, and thus room will be made for the extra molders needed for the larger output.

Under the present operating schedule half of the molders start work at 8 o'clock in the morning and the others begin a half hour later. Those who begin work first get iron at 2:30 o'clock and finish at 4:30 o'clock while the second gang is a half hour later in getting their first iron and in finishing. While the molders are waiting between ladles of iron they are not idle, but keep busy shaking out the castings they have poured and cutting the sand, so that before they leave at night the floor is in condition for them to start molding as soon as they arrive in the morning. On all floors which do not have stationary molding machines the sand is

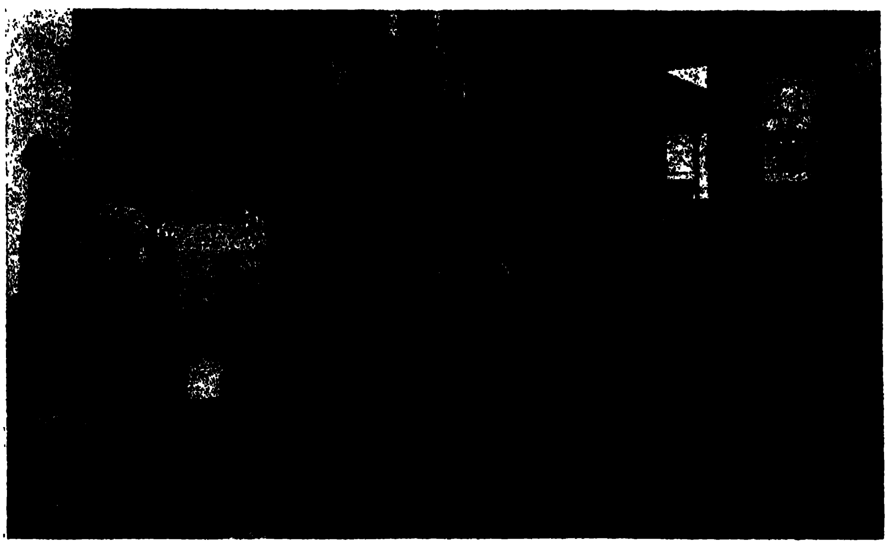

FIG. 4—FOUR CORE OVENS BURNING ARTIFICIAL GAS FURNISH SUFFICIENT DRYING CAPACITY

FIG. 6—SOME OF THE MACHINES ON WHICH MOLDS WITH CHILL CORES ARE MADE. NOTE THE TEMPLETS AT A FOR LOCATING THE CORES IN THE MOLD

cut into long narrow piles and the benches or squeezers are started at one end of the pile in the morning and moved along the heap as the sand is made into molds.

The coremakers work in a long, narrow room at one end of the foundry. The location of this room is indicated in Fig. 4, the room being back of the windows shown and at right angles to the ovens. The core ovens are fired with artificial gas. No pyrometer is used, as the ovens heat uniformly and are easy to regulate. Two of them were made by the Whiting Foundry Equipment Co., Harvey, Ill., and the others were manufactured by the Central Iron Works, Chicago. Twelve coremakers supply the cores for the 65 molders employed. The cores being small are all made with an oil binder.

Less than 20 per cent of the molds are now made on molding machines but new machines are being ordered as fast as the best method of molding each pattern is determined. At present the company has installed seven jar-ram rollover machines and five stripping-plate stands made by the Champion Foundry & Machine Co., Chicago, four squeezers manufactured by the Davenport Machine & Foundry Co., Davenport, Iowa, one roll-over machine made by Henry E. Pridmore, Chicago, and a stripping-plate machine from the Freeman Mfg Co., Racine, Wis. Beside the machines already installed several more

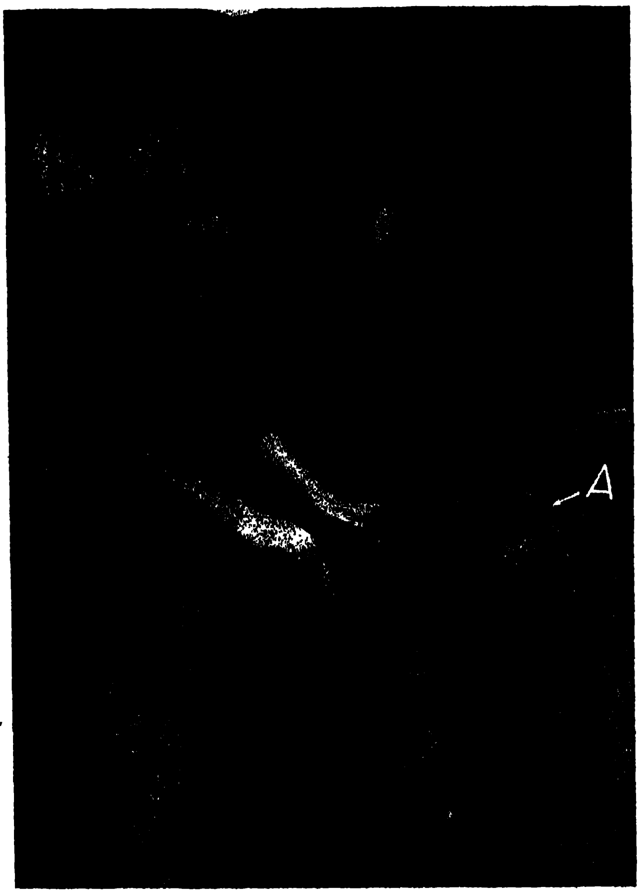

FIG. 7—STRIPPING-PLATE MACHINE IN WHICH THE HORN GATE MOVES WITH THE PATTERN

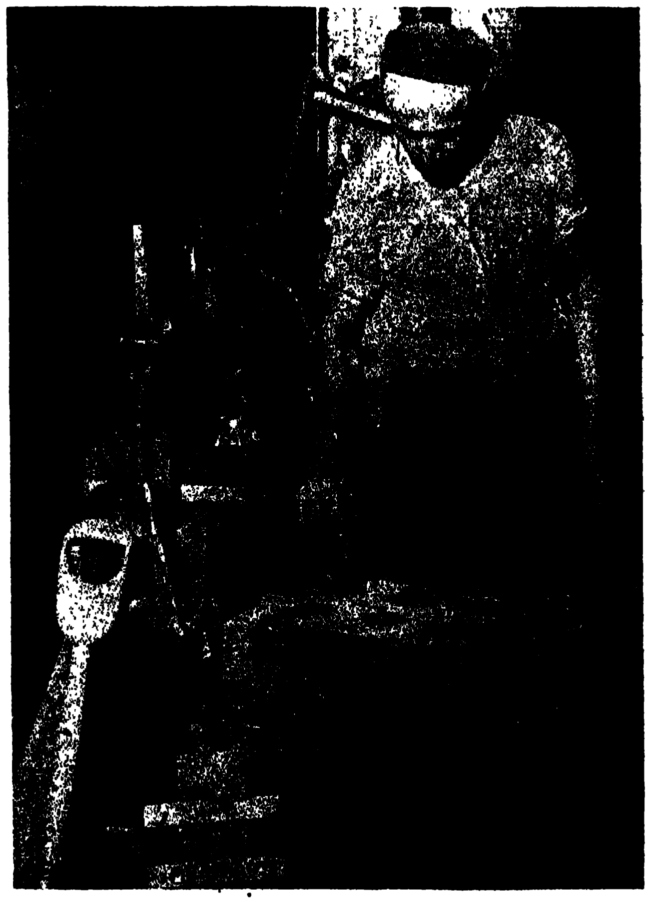

FIG. 8—PLACING THE CHILL CORES IN A MOLD

FIG. 9—THE FACE OF A COVER CASTING IS MADE SMOOTH BY USE OF A CHILL IN THE FORM OF A RING

FIG. 10—CLOSE VIEW OF ONE OF THE MACHINES SHOWN IN FIG. 6, READY TO START ANOTHER MOLD

are now on order and it is the intention of the management to have all the work made on machines within the next year.

A battery of four of the machines supplied by the Champion company is shown in Fig. 6. The machine from the Freeman company with a part of the day's work standing near it in the round flasks can be seen in Fig. 4. One of the stripping-plate stands is shown in Fig. 7. As it stands the pattern is half down and it may be noted that the horn gate at *A* is also partly lowered. This gate is drawn with the pattern by one movement of the lever.

One of the patterns which has not yet been put on a machine is shown in Fig. 5. Originally it was found that in drawing the pattern, trouble was experienced in getting a clean draw of the long, narrow end. On this account, the end piece was made separate from the rest of the pattern. In the illustration the molder is shown putting the loose piece over the projecting hub of the pattern. After the mold is rammed and the pattern drawn the loose piece remains in the sand. The loose piece is then withdrawn by the molder who places two fingers in it and turns it slightly, one way then the other, as he draws it out of the sand.

Machining Costs Reduced

All of the castings are made with the idea constantly in mind of saving as much machine-shop work as possible. One method by which machine work is avoided is by using chills which are employed in a number of instances, both in floor work and in bench work. These chills whiten the iron to a depth of not more than 1/16-inch which is not enough to be detrimental to the casting in any way.

The floor molding department occupies about 9 per cent of the area of the foundry. This department is shown in Fig. 2. The end-frame castings made from the pattern standing alongside the post near the center of the illustration are cast with chills at the ends of the legs and at the top surfaces. The portions of the castings next the chills ordinarily would require machining, but when the chills are used the casting surfaces are so smooth and true that machining is unnecessary.

Another job on which a chill is applied to good effect may be seen in Fig. 9. The pattern, in a sand match, stands to the left; on the opposite side of the molder is the cope; while the drag is on the bench before him. A circular chill similar to the one in the foreground has been placed in the drag

FIG. 11—PART OF THE SURFACE OF SOME CASTINGS IS WASHED WITH DILUTE SULPHURIC ACID TO FACILITATE MACHINING

FIG. 12—VIEW OF AN AISLE IN THE MACHINE SHOP SHOWING THE BOXES FOR HANDLING CASTINGS

and the molder is putting cores in the holes of the chill. The casting is a cover, and the chill makes a smooth, flat surface to fit against a bearing without being machined while the small cores sticking out of the chill make holes through which screws for attaching it are introduced.

Clutches are also cast with chills in order to avoid a certain amount of machine work. Many of the molds for these are made on the jar-ram rollover machines obtained from the Champion Foundry & Machine Co., Chicago. A close view of one of these machines is shown in Figs. 8 and 10. In Fig. 10 the machine is in position for placing the flask, and the pattern plate for the cope rests on the stand to the left. In Fig. 8 the drag has been made which does not require machining. The round flat piece forms a collar on the beveled gear end of the casting. The heavy metal on the other end of the core chills the metal in the clutch section of the casting and gives it a smooth finish. In this way bevel-gear clutch castings which do not require any machining operations are made rapidly in large numbers. Double clutch castings are made somewhat similarly except that the pattern and the chill cores are laid horizontally in the mold instead of being molded vertically as are the bevel-gear clutches.

Another method of cutting down on machine work is shown in Fig. 11. Here a workman washes the inside surface of shoe castings for ironing machines with a dilute solution of sulphuric acid. The excess acid runs into a receiver through a hole in the floor. The acid which adheres to the castings is allowed to remain and the castings are stood up to dry as can be noted in the illustration. During the washing and drying the acid eats the surface of the casting and so cleans it. This enables the machine shop to finish the casting with one cut on the milling machine.

FIG. 13—WOMEN ARE EMPLOYED IN THE FINISHING ROOM WHICH IS LOCATED BETWEEN THE FOUNDRY AND THE MACHINE SHOP

and the molder is setting the cores. Templets for truing the cores in position may be seen at *AA*, Fig. 6, and at the side of the machine in Fig. 8. The cores are kept in boards perforated with countersunk holes for holding them, *BB*, Fig. 6. One man sets the chill cores for the molds made on two machines with one molder working on each machine. These three men make an average of 173 molds a day.

In Fig. 1, George Nielsen, the foundry superintendent, is shown pushing the chill core out of a finished bevel-gear clutch casting. The assembled core stands on the bench at *A* while at *B* the core may be seen as it comes from the casting. The two pressed steel parts marked *C* are placed on the assembled core and are welded to the iron poured in the mold, remaining as part of the casting. The cylindrical piece goes through the center of the casting and forms a bearing surface

Girls and women are employed in the core rooms of many foundries, but in the Hurley foundry only one girl works in the core department, for cleaning cores. However, women are extensively employed in the finishing department. During the war this department was operated entirely by women, but recently female help has been more difficult to obtain and now only about a third of the employes are women.

Approximately 10 per cent of the castings are cleaned by a sandblast equipment manufactured by the Pangborn Corp., Hagerstown, Md., and the remainder are cleaned in tumbling barrels. From the tumbling barrels the castings go to the grinders and from there to the inspectors. The arrangement of these three operations can be seen in Fig. 13. The woman inspector in the foreground is looking over some bevel-gear clutch castings previously referred to in the description of molding operations. These castings must be carefully examined to make certain that the steel cylinder cast in for a bearing is smooth and has not been marred. On the bench to the front are end frames which have been cast with chills on the ends to give them a smooth, accurate finish.

The cleaning and inspection department is between the foundry and the machine shop. This location is the logical one for handling the work and makes the delivery of the castings to the machine shop convenient. In the cleaning room, the castings are loaded into boxes which run on four small wheels and are easily pushed along the floor to the machine shop.

Domestic Production of Tin Low in 1918

Tin is one of the few highly useful metals that is practically not produced in the United States proper. The output of tin from domestic ore in 1918 was only 68 tons, nearly all of it obtained from placers in Alaska.

The tin imported in 1918, as metal and in concentrates, amounted to 82,854 short tons the largest quantity yet brought into the country in any one year.

Deposits of tin ore are found in California, Virginia, North Carolina, South Carolina, South Dakota, Washington, Nevada and New Mexico, but the ore in some of the deposits contains so little tin that it cannot be mined with profit.

The concentrate from Bolivia was handled at four tin-smelting plants in this country, which produced from it over 10,000 tons of metallic tin.

A report on tin in 1918, by Adolph Knopf, has just been published by the United States geological survey, department of the interior, as a chapter of Mineral Resources for 1918 and can be obtained free of charge on application to the director of the survey at Washington.

The McLain-Carter Furnace Co., Milwaukee, has been awarded a contract by the Black Steel & Wire Co., Kansas City, Mo., for the installation of a 10-ton open-hearth furnace.

Slag Conditions in the Open Hearth

Reactions Which Take Place in the Acid Process—Names of Minerals Formed and Their Order of Freezing Given—Presence of Lime Protects Metal From Oxidation

AT A recent meeting of the British Iron and Steel institute J. H. Whiteley and A. F. Hallimond, M. A., Stockton-on-Tees, read a paper covering observations and experiments made upon the acid open-hearth process, particularly with reference to the action of the slag. The paper is divided into three sections and the following summary is given by the authors:

1.—The minerals present in slowly cooled acid slags without lime are tridymite, cristobalite, fayalite, and rhodonite; the last named contains the bases in very nearly the same ratio as the melt. The silica minerals freeze first, but supercooling always occurs to some extent. They are followed by fayalite or rhodonite, the silicate formed being determined by the ratio of iron oxide to manganese oxide; when this exceeds 73:27 fayalite is formed; in other cases, rhodonite. In slags containing more than about 8 per cent of lime, an anorthic metasilicate of CaO, FeO, MnO, MgO is obtained, which has a brilliant cleavage and gives rise to a marked acicular fracture in the slag.

2.—The order of freezing of the minerals in a number of slags whose analyses are given is represented in a ternary diagram, which is approximately that for the system FeO-MnO-SiO_2. A qualitative diagram is also given to illustrate the binary system FeO-SiO_2.

3.—Acid slags after being reheated for 18 hours at 1300 degrees Cent. contain free tridymite, and resemble the furnace hearth in structure.

4.—Spoon samples taken from the furnace are superficially oxidized to a depth which depends on the nature of the slag, and is least when the silica is high or when lime is present. The dull lustre of fractured glassy samples is due to minute particles of silica.

The Acid Hearth

5.—A number of analyses show that the hearth contains only 70 per cent of silica, although the sand used is required to contain at least 96 per cent.

6.—Microsections show that the upper layer consists mainly of interlacing plates of tridymite with interstitial slag; in the lower and cooler parts the quartz grains are less altered. The penetration of slag extends down to a well-defined limit, usually in the brickwork. The relatively small depression of the freezing point of silica in the presence of impurities is no doubt an important factor in the stability of the hearth.

7.—The effect of impurities in the sand is complex; apart from softening the bank, they give rise to caking and so prevent the absorption of the fluid slag on the bottom by the new sand —an action which is essential for the satisfactory repair of the hearth.

8.—The amount of ferric oxide in the hearth is considerably lower than that in the surface layers. This may be due to reduction by CO or metal, and to reaction with the silica present.

The Molten Slag

9.—The adjustment of the slag by the melter to the required degree of viscosity, and the manner in which the iron content is reduced by lime additions, are described.

10.—The proportion of carbon removed by gas-oxidation is estimated from experimental data for casts with and without lime additions. Between melting and tapping at least half the carbon is so oxidized, and this proportion is not greatly altered when lime is used.

11.—The physical conditions under which the molten slag reacts are discussed, and it is shown that during the boil one-half per cent of the metal is suspended as small globules in the slag, so that the reacting surface is greatly increased.

12.—The view is advanced that gas-oxidation takes place—(1) By the formation and reduction of Fe_2O_3 in the slag; (2) by direct contact of the metal and gas.

13.—Experiments are given to show that the proportion between ferrous and ferric oxides in a melt is determined by the silica content, the temperature, and the nature of the gases. In acid slag under ordinary furnace conditions the maximum, in the absence of reduction by the metal, appears to be about 4 per cent.

14.—Throughout the boil the content of Fe_2O_3 remains very low, 0.3 per cent, but may increase in the finishing period as far as 3 per cent. It is clear that the Fe_2O_3 must be very rapidly destroyed by the reducing action of the metal, which slackens as the carbon content falls and so permits the increase of Fe_2O_3 at the finish.

15.—The relative rates of various possible reactions between slag and metal are discussed. The constancy of composition of the slag in the later stages is due to a balance between the oxidation of iron from the metal, and the reduction of iron from the slag by the carbon. In an acid slag the latter reaction probably takes place mainly through the direct reduction of Fe_2O_3 rather than by the reduction of ferrous silicate.

16.—Of the carbon removed from the metal after melting, roughly one-half is removed by the ore, one quarter by gas-oxidation through the slag, and one quarter by direct contact between metal and gas.

17.—The effect of lime in the slag is to lower the Fe_2O_3 content; this action is probably of great value in protecting the metal from oxidation during dead melting.

Foundry is Reorganized

Reorganization and recapitalization of the Wheeling Mold & Foundry Co., Wheeling, W. Va., recently was completed, according to an official announcement by H. E. Field, president of the company. Under the plan of the reorganization, the holdings of the Wheeling Mold & Foundry Co. of West Virginia passed to the Wheeling Mold & Foundry Co. of Delaware.

The reorganization was brought about by Mr. Field who believed that the possibilities of the company might greatly be enhanced under his personal direction, backed up by the majority control of the common stock, the preferred stock having no voting power. Since the laws of the state of West Virginia do not provide for the issue of stock of no par value, it was necessary to reorganize the company under the laws of the state of Delaware. Mr. Field, who holds 51 per cent of the common stock of the new corporation, says that the company is not to be sold to other interests as has been rumored

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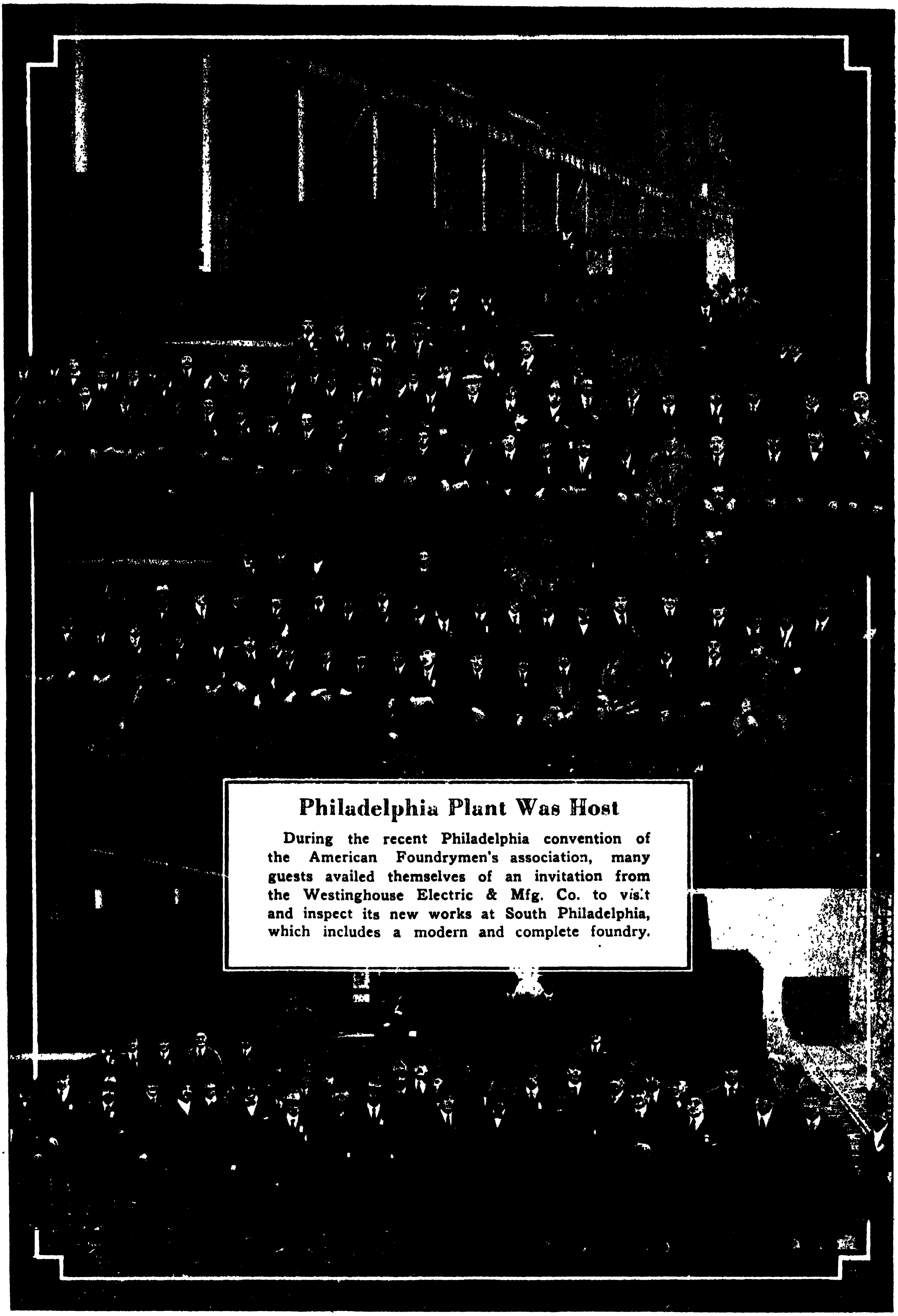
Since Oct. 1 the address of the Humphrey-Mills Co., has been 202 New Telegraph building, Shelby and Congress streets, Detroit, Mich.



Philadelphia Plant Was Host

During the recent Philadelphia convention of the American Foundrymen's association, many guests availed themselves of an invitation from the Westinghouse Electric & Mfg. Co. to visit and inspect its new works at South Philadelphia, which includes a modern and complete foundry.

Foreign Foundry Practice Analyzed

Fundamental Differences in Buyers' Requirements Render a Comparison Between American and Foreign Manufacturing Methods Unfair Unless Viewpoint is Understood — Steel Castings Ascendant

BY A. O. BACKERT

SEVERAL months ago the writer returned from an extended visit to England and France where he was afforded unusual opportunities to study conditions prevailing in the foundry and iron and steel industries. The people of both countries then were still suffering from the tremendous shock of the war and the readjustment of their industrial activities to a normal status was beset with many difficulties and problems that seemed almost insurmountable. Their national debt, which exceeds per capita many times that of the United States and the depreciated value of their money as measured by the dollar standard are causes for great concern among manufacturers and financiers. Otherwise conditions generally are not unlike those confronting us today. To provide an income for the great army of workers precipitated out of employment with the sudden termination of the war, a scheme of out-of-work pay was resorted to in the United Kingdom. Originally intended as a temporary expedient to tide over these workers, it threatens to become a permanent bonus for idleness at a weekly cost to the government in excess of $5,000,000. During the months of May and June more than 1,000,000 men and women were given this support from the national treasury and notwithstanding the tremendous shortage of labor in the metalworking industries, the number obtaining government support is increasing rather than diminishing.

Production Kept Down

In the United Kingdom the demobilization of the army was speeded up to a higher rate than in France. The return of millions of these men to peace-time pursuits, particularly those who have been out of touch with civil life for from four to five years involves difficulties that time alone can solve. In a comparatively limited degree, we too are familiar with the self-discipline involved in the transition of our soldiers from army to civil life and this, in only small measure conveys the situation existing in the United Kingdom and France.

It has been the prevailing practice of investigators of industrial conditions abroad to make invidious comparisons of production as compared with that of the United States. From the standpoint of tonnage and per capita output, particularly in the metal trades, these comparisons are borne out by statistics. However, there must be some underlying reasons for the wide divergence in these figures and more than a cursory examination revealed the causes. It has been pointed out frequently that restraint of output is the brake upon all industry of the United Kingdom and that with its removal production could be speeded up to equal that of this country. Attention also has been directed to the lack of labor saving equipment and the need of mechanical appliances to increase output.

Difference in Buyers' Standards

A more than superficial investigation of the foundry industry of the United Kingdom discloses the effect of the restraint of output, which, however, was removed during the closing years of the war and has not again been invoked. Mechanical appliances are not in such widespread use in the casting industry as in this country. Yet many plants are modernly equipped throughout and their practice is equal to the best prevailing in the foundries of the United States. Then what are the underlying causes for the differences in the rates of production? Why is the tonnage per man for shops engaged in similar work so much greater here than in the United Kingdom?

The wide divergence in the standards of the casting buyers of the two countries is one of the underlying reasons. The insistence upon high quality and superfine finish are two requirements that slow-up production abroad. The widespread use of dry sand molds in the United Kingdom and also in France, to provide the necessary finish demanded by the trade, is a large factor in reducing the per capita output. Quality and finish have been carried to the extreme and at the sacrifice of quantity. In the shops in this country, on the contrary, green sand practice prevails and quantity production is the goal to be attained, frequently at the expense of finish and quality. That a happy medium between the extremes of quality and quantity would serve the purpose cannot be denied, but years of education in one direction cannot be diverted to another course without an equal amount of training.

Repetition work in this country is one of the factors underlying large production and it lends itself admirably to the application of all kinds of mechanical and labor-saving devices. With us it is not unusual to make 50,000 castings from the same pattern and in the automobile trade this total frequently is exceeded. Dealing in large numbers of the same unit enables the American foundryman to equip for quantity production and he requisitions for his use the most modern mechanical devices available to increase output and reduce cost. In the United Kingdom and France, repetition work is not nearly so prevalent as in the shops of the United States. Quantity production of commodities is not appreciated in the same degree as over here, nor is the need for it nearly so great. Until this year quantity was not a great factor in the motor car industry abroad, and even today the largest output of the automobile plants of both of these countries is dwarfed by the annual production of many of our motor car manufacturers. Before the war, it has been stated that the total pleasure car needs of France was only 30,000 per annum. When this number is divided among many builders it becomes apparent that repetition work among French casting manufacturers cannot be developed to a very high degree.

Lack of Standardization

In addition, the lack of standardization in many of the engineering lines reduces repetition work to the minimum. Even the railroads are counted among the violators of standards in equipment and the whim of the designer too frequently is the altar upon which quantity production is sacrificed. It has been stated that manufacturers of sanitary ware in the

Abstracted from the presidential address of A. O. Backert at the opening session of the Interallied Foundrymen's Convention and Exhibition, Philadelphia, Sept. 30.

United Kingdom have patterns in their vaults for several thousand different designs of bathtubs and it is not unusual for an architect to enhance the beauty of his creation by individually designed tubs. Thus, the lack of repetition work may be assigned to a multiplicity of orders for small numbers of castings from different patterns and this plays havoc with production. Long runs from single patterns lead to production economies largely effected by the use of molding machines, whereas small orders for castings from a variety of models retard the installation of mechanical molding appliances, reduce the output and are a factor in maintaining the uneconomical practices of the jobbing shop.

To the comparative lack of repetition work in both the United Kingdom and France must be assigned the prevalence of the jobbing shop and the large number of small foundries, willing, even if not equipped for the production of castings in iron, brass or steel. However, this semijob work is not without its compensating features. It has a tendency to develop skilled molders, whereas our specialty shops train men to one operation, not one of whom could make a parting or cut a gate by hand. Notwithstanding these handicaps, the mechanical equipment of many of the foundries of the United Kingdom and France measure up to the best practice prevailing in this country. And the foundrymen of these countries are alive to the progress that is being made in casting manufacture over here. They are anxious to increase their production and to reduce their costs and to attain these ends they are preparing to install labor-saving equipment on an extensive scale.

Steel Casting Manufacture

Steel casting manufacture in the United Kingdom was greatly accelerated by the war. The output in 1918 totaled 276,518 tons, of which basic steel was only 10,564 tons as compared with 265,954 tons of acid castings. This tremendous predominance of acid over basic steel, which is in striking contrast to the practice prevailing in this country, must be attributed, to a large extent to the insistence of the army and navy ordnance departments for castings made by the acid in preference to the basic process and also, in a measure, to the available ores. The war also speeded the installation of electric furnaces for the production of steel for casttings. At the time of the armistice, 37 were in operation in foundries with an actual output of more than 5000 tons per month and 11 additional were being installed which will increase the actual production to 7000 tons per month.

When the war was terminated, electric steel casting production was at its height in the United Kingdom, as indicated by the output of 46,637 tons in 1918 and compared with 108,296 tons for the United States in the same period. Of the total steel casting output of the United Kingdom in 1918, the electric process accounted for 17 per cent against 7.7 per cent for the United States, indicating a production in proportion to the total steel casting output more than twice as great as that of this country.

A further analysis of the steel casting statistics for both countries in 1918 reveals striking differences in practice. Steel for casting purposes made in converters in the United Kingdom exceeded open-hearth production by 1936 tons, the former having totaled 116,231 tons against 113,630 tons for the latter. In the United States, on the contrary, where the open-hearth process predominates, the production of converter steel last year was 160,844 tons as compared with 1,140,830 tons of open-hearth steel. In the United Kingdom converter steel represents 42 per cent of the output as contrasted with 11.3 per cent in this country and open-hearth only 41 per cent against 80 per cent in the United States. Among the converter processes employed in the United Kingdom the Tropenas leads with 53,633 tons; the ordinary side-blow process is second with 48,858 tons and the Stock, oil-fired converter is third with 13,075 tons. Classified as basic converter steel is 665 tons. No records of the production of steel castings by the crucible process in the United Kingdom are available, and statistics of last year's output in the United States indicate also that this process is passing in this country. Statistics of the steel casting production of the United Kingdom and the United States for 1918, follow:

	United Kingdom Tons	United States Tons
Acid open hearth	103,731	634,950
Basic open-hearth	9,899	505,880
Converter	116,231	160,844
Electric	46,657	108,296
Crucible	......	1,330
Miscellaneous	......	110
Total	276,518	1,411,410

In many of the English plants the combined installations of cupolas and converters are unique. For the purpose of eliminating the handling of the metal in ladles from the cupolas to the converters, the melting furnaces are located on platforms at a considerable height above the floor level to permit of tapping the iron direct from the cupola spout into the mouth of the converter. Troughs are provided for directing the metal into the mouth of ether converter, one being located on each side of the cupola.

Following the curtailment of ordnance buying and the cancellation of existing contracts in November last year, many electric furnaces in steel foundries were shut down and the production this year will show a material decline in the United Kingdom. This is due to the high cost of manufacturing this grade of steel and the comparatively limited demand for electric steel castings for commercial purposes.

Book Review

Foundry Practice, a text book for molders, students and apprentices, by R. H. Palmer; cloth; 390 pages, 5 by 8 inches; published by John Wiley & Sons, Inc., New York, and furnished by THE FOUNDRY for $3.00 net.

The second edition of this book has just been published, much of the text has been rewritten and subject matter has been added. The additions include a description of the rigging and flasks and details the processes of securing and pouring molds to produce large propeller wheels economically. Other new matter in this edition deals with the patterns, flasks, cores, molding, setting and securing cores, gating pouring, and testing the iron for locomotive slide valve cylinders. Additional information also is given on casting locomotive superheater cylinders, casting lathe beds and chilling the ways, making cores for gasoline engines and cylinders, and molding large kettles.

As in the previous edition this book goes thoroughly into the question of molding in its every phase. Greensand molding is considered first, and methods are described for molding irregularly shaped patterns including gears. Pit molding, floor molding and bench molding also are described. Dry sand work and loam molding are fully detailed. After the subject of making and setting cores is finished, the questions of molding machines, sand and metallurgy of iron are presented. Under metallurgy might be classed the chapters on iron and its composition, the treatment of castings while cooling, mending broken castings, and the chapter on the cupola and its operation. In the back of the book is a glossary giving definitions of foundry terms and a number of tables containing useful data for the foundryman.

The S-T Engineering Corp., Buffalo, has been incorporated with a capitalization of $100,000 to manufacture and sell mechanical equipment.

How to Care for Foundry Equipment

In Order to Get Anything Like Adequate Production From Labor Saving Machinery It Must be Looked After Intelligently, Lubricated Freely and Given a Fair Trial

BY G. L. GRIMES

A MOTOR car has to contend with the dust of the road, it operates under far better conditions than obtain in the average foundry where dirt and grit attack the bearings of equipment. Most men make it their business personally to see that their automobiles are oiled, but how many give as much thought to the care of their foundry equipment?

It is generally expected that there will be a large exodus of foreign labor and probably comparatively little immigration. The second generation of foreign labor does not care to go into the foundry but prefers the machine shop. The decrease of labor and the increased demand for better and larger output, combined with the growth of the idea of the conservation of material and resources, forces the foundryman to face new conditions; he must develop new methods and processes and make up for the shortage of men by the installation of more machinery. The addition of machinery brings with it the problem of maintenance.

Manufacturers realize that they have made an investment for capital account when they buy a lathe or milling machine for the machine shop. They install it in a clean, well lighted shop. Each operator is required to keep his own machine clean and many shops allow special time for this purpose. Machinists are trained to oil their own machines, and a man is made responsible for oiling the lineshafts and motors. A tool room, with the best mechanics in the shop, is usually provided to repair the equipment when it breaks down.

Foundry Machinery Often Neglected

But this policy does not seem to hold true in regard to foundry machinery. In many cases, the machinery is purchased, and no more attention is paid to it as long as it runs. The foundry process is a dirty one. The sand and dust that flies when the molds are being shaken out covers everything in the foundry, and many foundrymen act as if it is useless to attempt to keep machinery clean. When installing equipment, many neglect to provide a proper place for it. Think of installing a motor driven air compressor in the dust of the cleaning room! But it is done.

Some foundrymen allow the night gang to shovel the sand back covering the molding machines so that the operators have to dig them out every morning. This delays production and damages the machines.

A steel foundryman called the manufacturer of his sand mixer and claimed it would not work properly. The equipment manufacturer found that the main bearing had not been oiled and the brass was nearly worn out, yet the foundryman wanted it replaced free of charge.

If an automobile begins pounding and the garage man has to put in new rods or bearings, the owner does not expect him to replace the parts and throw in the labor because the machine was purchased from him.

The change in foundry methods caused by the introduction of machinery is calling for mechanical training that was not necessary with the old floor methods. Too many foundrymen depend on their hunches that the equipment is all right or not. Often when foundry superintendents and foremen are changed, the entire equipment is changed. This is an economic waste which reacts seriously on the industry. Equipment is often condemned when it only needs a little intelligent care.

Many foundries buy equipment for certain work and when that is completed, the equipment is taken out into the back yard and allowed to rust. When it is needed again it is found to be ruined. A little care in covering it up and slushing with grease would save thousands of dollars every year.

Others, when their molding machines are out of service, allow bottom boards, old shoes, shirts and all sorts of trash and dirt to accumulate on them. When a job comes that could be run on the machine, it is too much bother to dig it out.

The logical and cheapest way to reduce the foundryman's worry is to hire a competent master mechanic or upkeep man to look after the mechanical details of the equipment in the foundry, as is done in rolling mills, machine shops, paper mills, etc.

Fully 95 per cent of the trouble with foundry equipment is due to improper lubrication. Where it is possible heavy grease should be used on revolving shafts as it will form a collar of grease outside the bearing, making the finest dust protector possible. On some sliding surfaces on handrammed molding machines, ordinary plumbago or facing makes an excellent lubricant as the sand does not stick to it. One superintendent experimented with different oils on his molding machines and found that the fuel oil used in melting furnaces washed the sand out of the sliding surfaces and had enough body to properly lubricate the surfaces.

Novel Method Insures Oiling

The complaint is heard that the men do not seem to take the interest in their work they formerly did. In order to have some check on the man in care of machines, one foundry has installed a watchman patrol system with a key at every important bearing, machine and motor. The oiler carries the clock, which he must ring at every station. By this clock record, the superintendent at least knows that the oiler has visited each place.

When a molding machine is out of service in this plant, it is cleaned up and boxed to protect it from dirt. The boxes are arranged to be easily taken apart and stored when not in use.

An automobile foundry realizes that the operators do not take care of the machines or patterns properly, so when the day's work is finished, one man blows off, cleans and oils the molding machines. A second man cleans the patterns and puts a tarpaulin over the machine so the dust will not get into the machines. These measures insure that the machines will be ready next morning for the scheduled production.

Abstract of paper read at the twenty fourth annual convention of the American Foundrymen's association held at Philadelphia Sept. 29-Oct. 3. The author, G. L. Grimes, is president of the Grimes Molding Machine Co., Detroit.

Enlarges Malleable Shop

The Link Belt Co. is making an addition to its Belmont foundry at Indianapolis, in order to take care of increasing demands for malleable iron chains. The new building will be about 70 x 400 feet. The company intends eventually to install two furnaces in this building, but at present only one furnace is being erected. This furnace will be of 15 tons capacity instead of 10 tons like the present furnaces. Additional foundry equipment to handle the increased melt is being purchased and installed.

Making Castings for Giant Lathes

Mammoth Machine Tools Required for Machining Huge Guns Demanded Exceptional Skill in all Processes — Precision Attained in Castings for Super-Gun Lathes

SOPHISTICATED as we are to the stupendous numbers and mammoth machinery of the great war, receiving each new revelation of engineering accomplishment with expressions of admiration grown meaningless through reiteration, it is doubtful if any clear perception of details is registered. We read of the hundreds of ships, the thousands of guns, the millions of rifles and the billions of grenades which were made, and focus upon these items which are only the measure of accomplishment. Grouped behind these visual markers which serve only to gage the tremendous force of modern war is an infinite power of shop activity which the mind does not readily conceive. Few indeed are those who think back of the finished engine of war, and analyze the factors which went to make it.

It is difficult to appraise at true value the great amount of preparation which goes into equipment necessary to manufacture war munitions. Each truck, each gun, each tank or tractor represents a cumulative effort starting with the design and construction of the tools to build it, and often this preliminary work in itself is stupendous.

Consider one of the largest naval guns, ponderous and imposing, but finished to the ultimate of precision. The engineering skill and workmanship upon it is evident. It represents a definite accomplishment which is apparent even to the casual observer. But greater than the gun itself is the tool by which it is machined. In the April, 1918, issue of THE FOUNDRY a description was presented covering some of the main castings made for special gun lathes. The machines mentioned were described as 102-inch gun lathes, some of a number ordered from the Niles works of the Niles, Bement, Pond Co., Hamilton, O. It now is possible to present some further details concerning these lathes, and the foundry problems connected with building them. Over two years ago the navy department ordered four

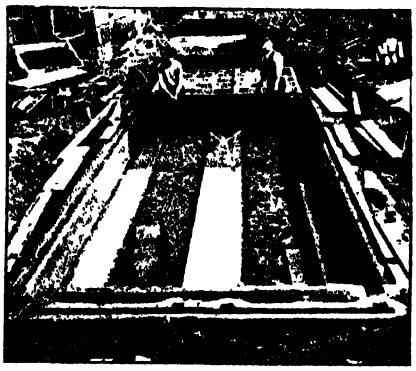


FIG. 1—RAMMING THE LAST OF FOUR PARTS OF A BED SECTION—NOTE THE CHECKS LOCATING THE SEGMENT PATTERN AT A

of these great machines for boring large guns. These were specified as 102-inch swing. Later 11 lathes with 120-inch swing were ordered and finally a repeat order was placed for four of the latter size mentioned. This work has engaged the main efforts of this great foundry continuously for almost two years. A drawing of one of these mammoth machines—the world's largest lathe—is reproduced, Fig. 2. It may be noted, that the main castings required are the headstock base, the cap-casting for the headstock, the bed sections and the boring-bench sections. On account of their size, intricacy and the imperative need for perfect surfaces where machined, the production of these castings involves interesting foundry practice.

The headstock base casting weighs about 70,000 pounds, each of the boring bench sections weighs over 43,000 pounds and the bed sections are from 68,000 to 73,000 pounds in weight. Early in the present year 13 of the headstock boring bench castings had been made and machining proved them to be structurally perfect.

As may be seen in Fig. 2, the bed of the lathe is formed by seven sections, which when bolted together stretch out over 200 feet. Three sections are bolted together to make the complete boring-bench, which carries and guides the boring bar. The lathes have no tailstock, but are provided with a series of steady-rests in which the work is turned as the bar travels forward. The bed, boring-bench, and headstock castings, it will be appreciated, must be cast within close tolerances to allow machining to the precision which is demanded in these tools.

Similarity permits the bed sections to be molded from the same patterns with the proper conjunction pieces. The four sections at the headstock end of the machine are the same. They are 10 feet wide and from 30 to 35 feet long. The remaining three bed-sections are only 6 feet wide and about the same length.

The bed-sections are all molded in pits. A preliminary bed of coke

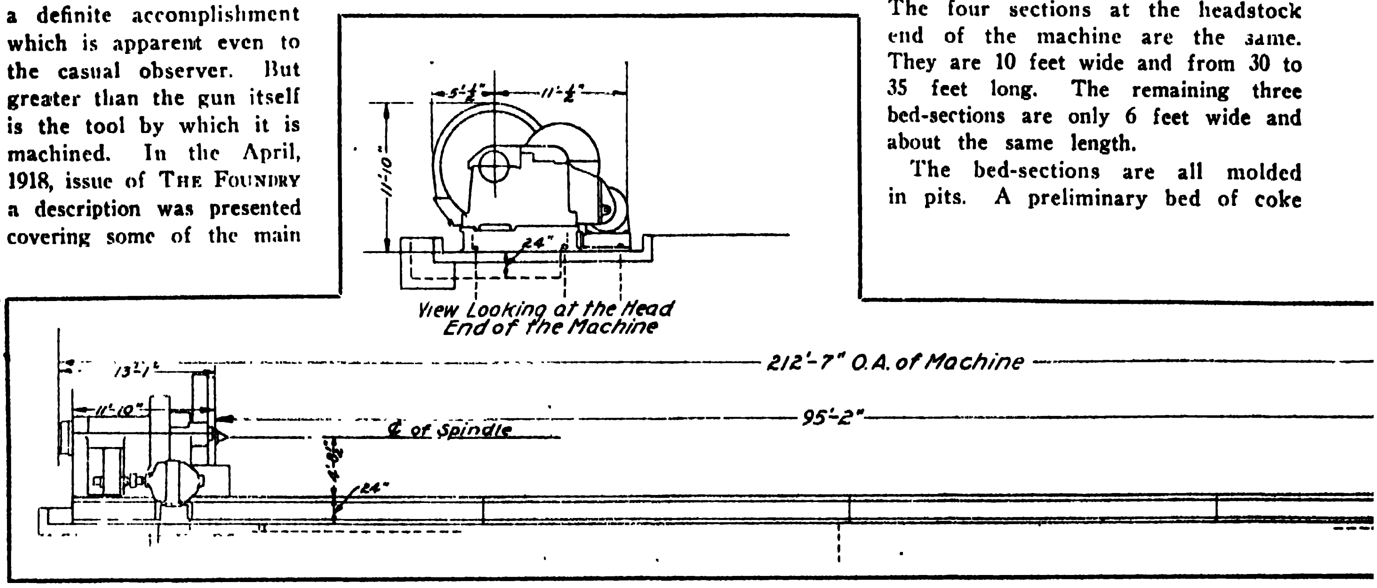


FIG. 2—NO ADEQUATE CONCEPTION OF THE GREAT SIZE OF THE LATHES CAN BE GAINED FROM A MERE DRAWING—SEVEN LONG SECTIONS ARE

FIG. 3 BED SECTION AS IT COMES FROM THE SAND—NOTE THE BARS WHICH SUPPORT THE HANGING CORES FROM THE COVER CORES

is laid Upon this heap sand is placed and leveled to the same height as the straight-edges in the bottom of the pit. Sweeps are next employed to form grooves for core prints between the straight edges. A sectional pattern then is moved along, resting upon the straight-edges as shown in Fig. 1 and lined by checks, *AA*, which fit the print grooves. The pattern is moved forward four times and rammed successively until the outer contour of the bed section is formed. The inner webs, and channel sections are formed in dry sand cores, which are made separately in core boxes, provided with stop-offs to give the desired length. These are practically cover cores. As the bed sections are molded with the upper or machined face down, it is imperative that there shall be no chaplet marks in the surface. For this reason it is necessary to suspend the inner cores from the top and hang them on the cover cores. This method of coring is illustrated at *B* in Fig. 4. Straight core arbors are used, and are wired together at right angles to support the hanging portion of the core upon the flat cover portion. The cover cores are outlined by dotted lines in Fig. 4. The bars which support the hanging cores, also may be noted in Fig. 3, which shows one of the bed sections as it came from the sand. A ¾-inch dip is provided at the center of the mold to compensate for warping in the bed casting as it cools. The T-slot shown in the center channel of the base in the cross-section presented obstacles to the usual method of coring. This slot, shown at *C* in Fig. 4 is machined on all surfaces and must be sound throughout. Any system of coring to provide this slot would have been subjected to a tremendous crushing force from the weight of metal above, and cooling stresses would have jeopardized the overhanging section. It therefore was decided to cast this portion solid as shown by the dotted line and machine the slot entire.

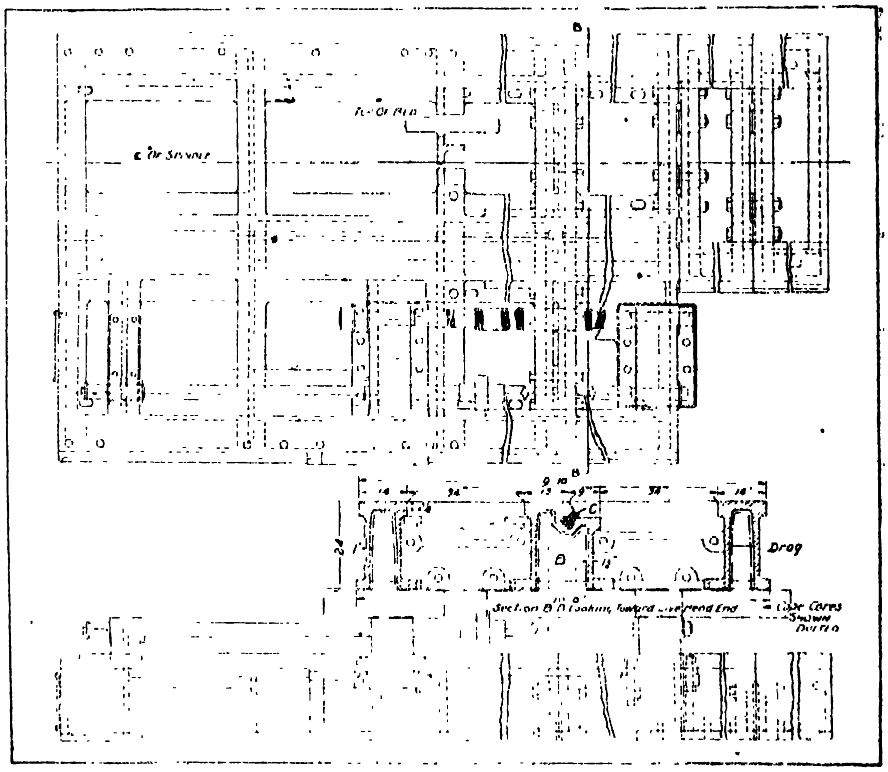
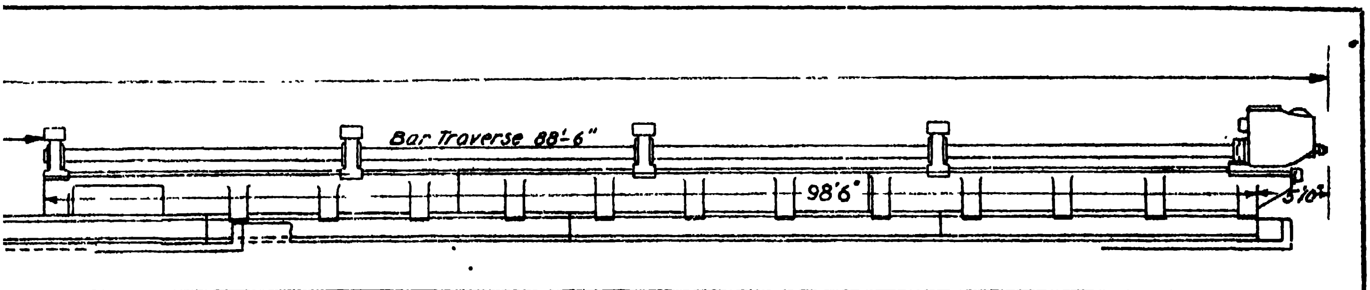


FIG. 4—PLAN AND SECTIONAL VIEW OF BED SECTION—THE SYSTEM OF CORING IS INDICATED BY THE DOTTED LINES IN THE SECTION *B B*

The great lifting force which one of these sections exercises will be appreciated from the amount of area which is shown in the finished casting. To counteract this force, an ingenious system of weighting is used. This may be understood more readily from Fig. 5. When the cover-cores are placed over the entire mold, a series of railway rails are laid longitudinally so



REQUIRED TO FORM THE BED, WHILE THREE SEGMENTS BOLTED END TO END SERVE TO SUPPORT THE BORING BAR WITH ITS 88-FOOT TRAVERSE

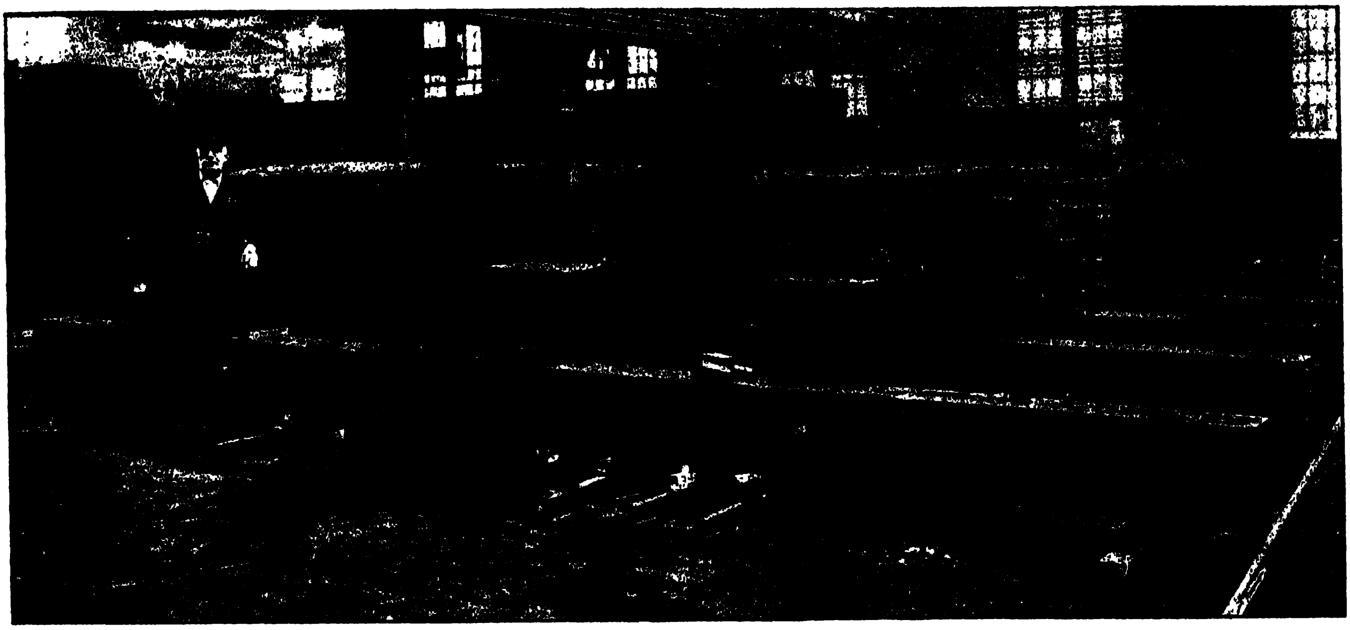


FIG. 5—SYSTEM OF WEIGHTING THE HEAVY PIT MOLDS FOR POURING—THE WEIGHTS ALL ARE SUPPORTED ON LINTELS AT A SAFE DISTANCE FROM THE EDGE OF THE MOLD

that each separate core has a bearing against two or more rails. Then cast-iron lintels are laid alongside the mold, 5 or 6 feet back from the edge. Upon these are placed the transverse weights shown in Fig. 5. These extend across over the mold and upon them is piled a series of weights as shown. This arrangement allows the entire weighting system to be carried upon the lintels along the side, so that there is no danger of crushing in the sides of the mold, nor the cores. The rails resting upon the cover cores are wedged firmly against the weights above, so that any lifting force is transmitted to and resisted by the weights. The cast-iron blocks used weigh from 8 to 12 tons apiece, and are provided with side lugs to which the crane chains may be attached for handling them about the shop.

In pouring the bed-section molds, metal enters the mold from both ends simultaneously. One of the runner-boxes is shown in Fig. 5. A similar box is located at the far end of the mold. Two runners lead to the bottom of the mold at each end and from this point the metal flows along the main channels at the center, around the outer walls and up until the entire mold is filled. Eight risers are used, each 4 x 6 inches. This liberal riser capacity is an additional insurance of sound metal.

Metal is tapped from two of the three cupolas with which the foundry is provided. Three ladles are used in pouring. The metal is started at one end from a 25-ton ladle. Over the center of the mold a second crane holds ready a 10-ton ladle, while at the opposite end a third crane holds and pours a 10-ton ladle from which the second runner cup is served. As the first 10-ton ladle is emptied it is swung away and the reserve ladle over the center is brought in place and tilted to continue the pouring as nearly without interruption as is possible.

Removing the gates and risers from these large bed sections constitutes a problem. It is sometimes found that although liberally nicked around the base the ordinary sledge does not serve to jar them loose. In this event a 2000-pound weight is suspended from one of the overhead cranes and placed against the offending riser. Two men then pull it back as far as possible and allow it to swing and strike the riser. The inertia force usually is sufficient to break the head from the casting.

FIG. 6—MOLD FOR BORING-BENCH SECTION WITH ONE PART OF THE COPE REMOVED—DRAWING THE LOOSE PIECES WHICH FORM THE WINGS

The procedure in molding the boring-bench castings is somewhat similar to that employed on the bed-sections. In this case the pit is prepared with the sub-bed of coke and the surface of sand, swept level with the straight-edges in the bottom and a central recess running the entire length of the mold is bedded in to receive the core print. Light sectional patterns with loose pieces shown at the side of the mold in Fig. 6 then are placed and rammed. As may be noted the boring-bench is molded with the sliding surface up, in an inverted position to that which it occupies when assembled in the machine. With the pit portion, or drag half of the mold rammed, two large flasks are placed to form the cope. These are barred, rammed in position, and eight liberal risers are formed, one being placed over each of the "wings," or slide-arms, of the bor-

ing bench. The corners of the flasks then are located by stakes; the two cope sections are removed and set upon supports which elevate them above the floor to a height of about 3 feet. Corrugated iron sheets then are placed about the sides and the copes are dried by a charcoal fire.

A number of cores are used to form the central cavity. These cores are supported upon prints in the bottom of the mold box section of the boring-bench casting. The complete assembly of cores is shown in Fig. 8. The cores for the side-arms are supported at one end by the central core and on the under side by core prints which rest on the bottom of the slide-arm recesses. All cores are provided with ample vent openings, filled with coke and protected from inflowing metal by the rings of fireclay and sand shown about each of the core-vent openings in Fig. 8. Two pairs of draw-gates each fed by a common runner are used to pour the boring-bench castings. Each gate is 2 x 2 inches, and a 4 x 4-inch section is provided in each of the risers. Two 11-ton ladles are used to pour simultaneously from opposite ends.

The headstock castings present the most complicated problem in molding. The drawing reproduced as Fig 12, and the two views of the casting shown in Fig. 11 illustrate the intricacy which, when combined with great bulk, make this piece the most difficult to mold. These great blocks, weighing over 70,000 pounds, support and, with a lighter cap-casting, house the turning mechanism for the huge lathe. It was found expedient to mold them with the upper surface down, to aid in coring the lower half of the driving-gear housing, shown at *D*. This feature necessitated a draw-back about the corner in which this portion was molded. This method was developed by the foundry superintendent, Louis Baden, who has been largely responsible for the success of this large lathe work.

FIG. 7—MOLD FOR BORING BENCH SECTION COMPLETED AND BLACKED READY TO RECEIVE THE CORES

The pit first is prepared as in the case of the other castings for the heavy lathes. An additional space is allowed around the corner in which the draw-back is to be formed. Sheeting is set up along the three walls of this portion of the pit, and inside of this and held apart from it by wedges is a second lining of sheeting. A heavy plate with lifting rods is placed in the bottom of the pit, occupying practically the position shown by the dotted lines in Fig. 12. A bed is prepared in the customary manner, and the pattern pieces are set.

A parting is formed dividing that portion of the mold which overhangs the lifting plate from the rest of the mold, but with this exception the mold is rammed in the usual manner. The cope flasks next are set, rammed and removed. The wedges between the two walls of sheeting then are removed, and the plate carrying a portion of the mold surrounding the driving gear housing is drawn back and lifted from the pit. The cores now are placed without difficulty and the portion of the mold which has been lifted out is replaced and sand is rammed solidly back of it.

Another difficulty is encountered in placing the cores in the heavy frame section shown at *E* in Fig. 11. The two outer and center walls are pierced by circular openings which are on the same line, and these openings have hubs or bosses extending from the walls to give additional support and rigidity to the motor drive shaft of the lathe. To accommodate these hubs, it is neces-

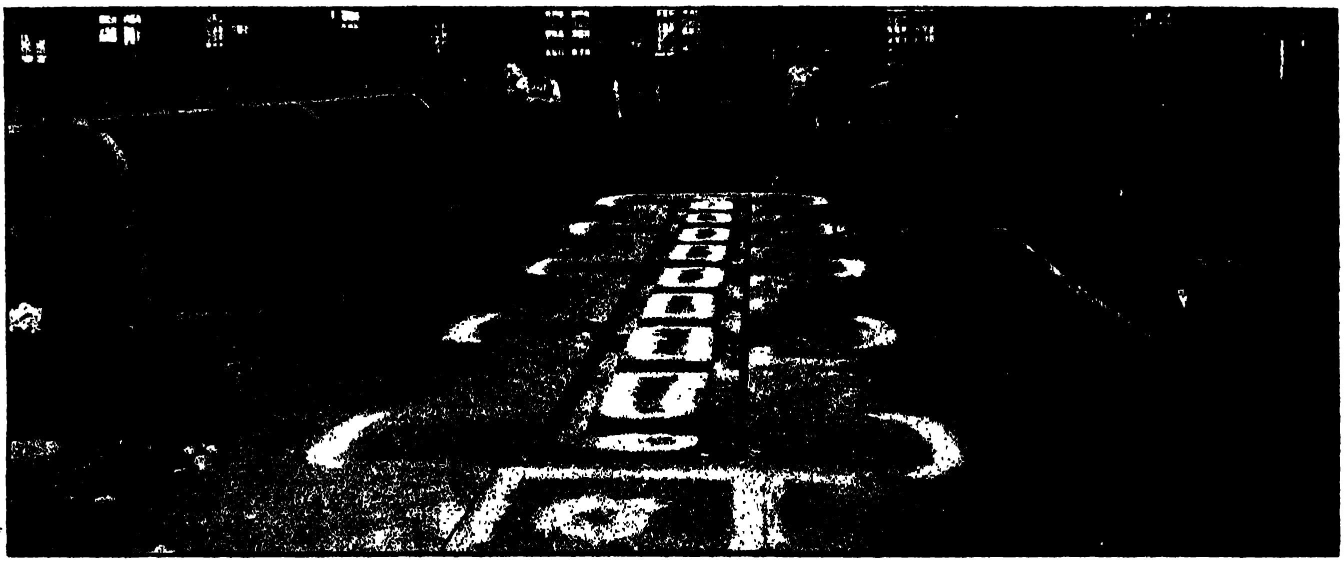


FIG. 8—COMPLETED MOLD WITH CORES IN PLACE READY TO POUR THE BORING-BENCH SECTION—NOTE THE LIBERAL VENTING OF ALL CORES AND METHOD OF SUPPORTING THE WING CORES AGAINST THE CENTER

sary to split the inner cores horizontally. This allows the core forming the circular openings through the three walls to be made in one piece and insures the alignment of the three holes. The lower halves of the inner cores are held up by prints which extend through at the points *F*, and are supported laterally by prints carrying through to the side of the mold. The larger recess shown at *G* with the inner hub are formed from cores.

The percentage of loss in these headstocks has been practically nil. Four risers, 6 x 6 inches in size, are provided in making these castings. The metal is poured into two draw gates located at opposite corners.

The molds for the bed-sections, boring-benches and headstocks are all blacked thoroughly before drying with a preparation of plumbago, talc and core-wash. After blacking, each pit mold is covered with strips of corrugated iron and two or more oil torches, placed at opposite ends, serve to skin-dry the mold in about five hours' time. The torches are moved about from place to place at intervals, either by the workmen on the floor or by the night-watchman, in order that all portions of the mold may be dried evenly.

It will be appreciated that good metal and high pouring temperature are necessary to assure sound castings on this class of work. The average analysis showed about 2 per cent silicon, from 0.50 to 0.55 per cent manganese, 2.49 per cent graphitic carbon, 0.59 per cent combined carbon, 0.82 per cent phosphorus and 0.10 per cent sulphur. Three large cupolas, built by the predecessors of the Whiting Foundry Equipment Co., Harvey, Ill., provide ample capacity for this heavy work and in addition for a variety of medium and light castings needed in the company's tool building shops. The cupolas are lined to 48, 60 and 68 inches, respectively. During the war, with the stress of hurried production, this foundry melted about 75 tons per day. The production since has averaged 60 to 65 tons per day on all classes of work.

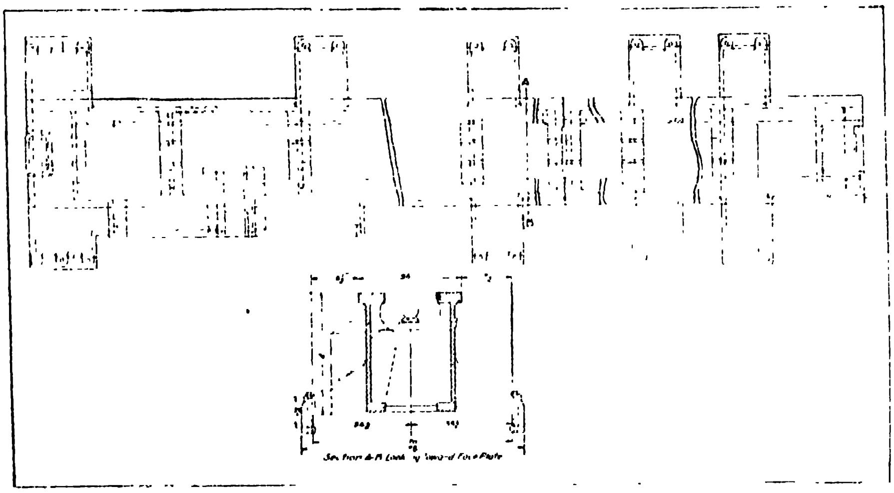


FIG. 9—PLAN AND SECTIONAL VIEWS OF THE BORING BENCH CASTING

Great efficiency governs the handling of materials to the cupolas, as well as carrying the metal to the pouring floors. The storage yard which adjoins the foundry building is served by two 10-ton Niles cranes. One of these commands the scrap, iron and coke piles. The other reaches over the sand storage. A 25-ton crane extends over the yard where many of the finished castings await transportation to the machine shop. An ingenious feature has been provided to obviate the use of timbers, which usually are employed to prevent castings from resting on the ground. Concrete walls have been built which are elevated about 6 inches above the ground. These are about 12 inches wide and the edges are formed by the corners of angle bars which are tied together at intervals by bolts embedded in the concrete. The walls provide a permanent foundation upon which to pile the castings until needed, and are protected from chipping and abrasion by the angle-bar edges.

The cupola materials are handled by the crane from the storage yard to an elevated platform at the same height as the charging floor, but outside the building. Trays holding from 8000 to 10,000 pounds are used to convey the scrap and pig iron to the outer platform, where they are lowered upon light trucks and wheeled to the charging floor. Here the mixtures are made in light charging cars which run from floor scales to the cupola doors. Cans, holding about 125 pounds each, are filled with coke at the yard pile. Sixteen of these are placed upon a platform which is picked up by the yard crane and swung to the elevated platform where it is placed on a truck and wheeled in to the charging floor.

Care is taken to have a great quantity of sand in storage at all times in this plant. Ten roofed yard bins of 160 tons capacity each, provide facilities for reserve and allow the company to ship and fill its requirements before

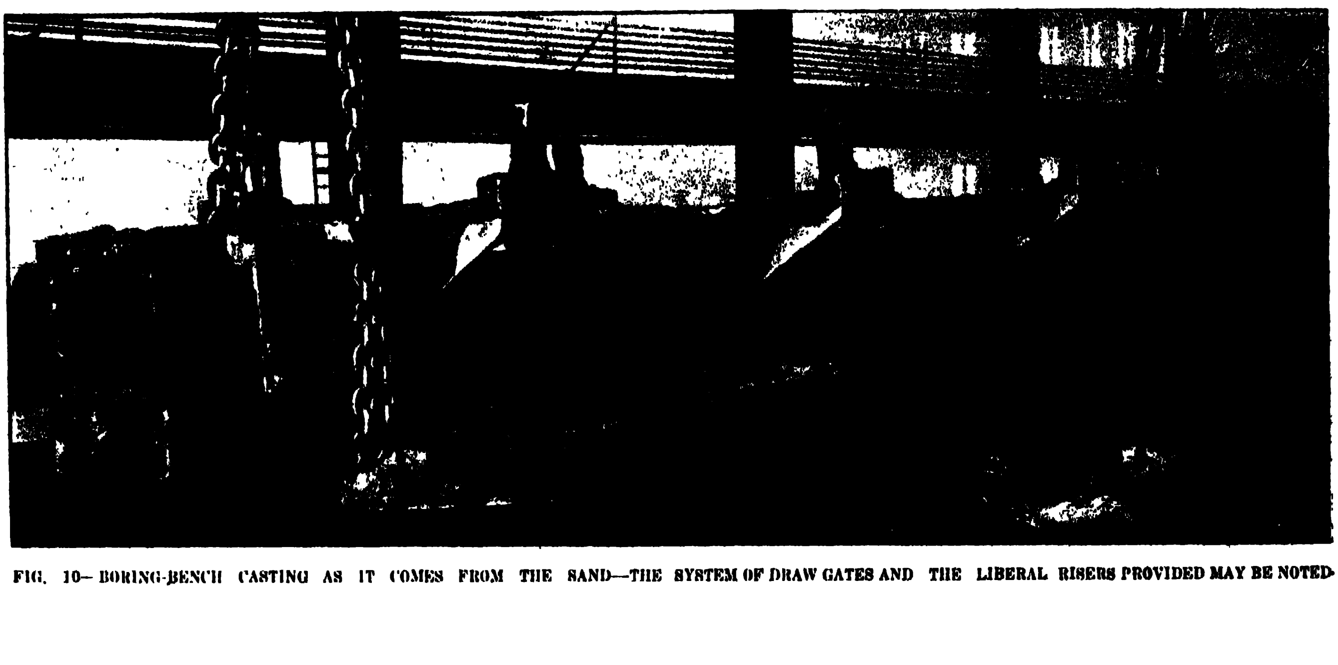


FIG. 10—BORING-BENCH CASTING AS IT COMES FROM THE SAND—THE SYSTEM OF DRAW GATES AND THE LIBERAL RISERS PROVIDED MAY BE NOTED

FIG. 11—TWO VIEWS OF THE LARGE HEADSTOCK CASTING—THE LOWER HALF OF THE MAIN DRIVING GEAR HOUSING, SHOWN AT THE END NECESSITATED THE DRAW-BACK

November of each year. Thus no sand is shipped in during bad weather, and that which is at hand has an opportunity to dry and condition before it is needed. A 700-ton bin inside the foundry supplies the daily needs and is kept filled from the outside sheds. From this bin the sand is wheeled and shoveled into a disintegrator which breaks the lumps. It drops from this machine upon an elevating conveyor which carries it to a revolving riddle type Standard mixer through which it travels and drops into a hopper. This hopper empties upon an elevating conveyor which carries the sand up and drops it into overhead storage bins. Drop shutters in these bins allow the sand to run into steel boxes in which it is conveyed to the various parts of the foundry as needed, or upon heaps beneath the bins adjacent to the light molding floor.

Jeffry storage-battery trucks with trailers are used to carry the sand from the side bay to the main floor where it is picked up by cranes and placed where needed. The trucks also are used to move ladles of metal from the cupolas to the side floor bay.

It will be realized that this plant must be unusually well equipped with cranes. The central floor where the heavy work is handled is served by three 30-ton overhead, girder type cranes, and three 6-ton traveling jib cranes supported and traveling along the line of columns separating this floor from the two side bays. Two of the three 30-ton cranes are required to pull the large lathe sections from the sand and to convey them to the cleaning floor.

Over the side bay in which the castings up to 20,000 pounds or "medium" work is handled, are four 10-ton Niles overhead girder-type cranes and six 3-ton traveling jibs. The latter are in constant service, moving flasks, boards, and sand and rolling-over or closing molds. The overhead cranes are used for all pouring work on this floor.

The Niles foundry is remarkable for its exceptional fire prevention features. All floors in all departments have complete sprinkler systems. It would seem that this would be unnecessary precaution in the main foundry building with its steel-frame, brick-wall construction, where no wood flasks and little other material of inflammable nature is used. However, the wisdom of the measure was proved while one of the large lathe castings was being poured.

Two ladles were in action, each controlled by hand wheels on the ladle frame. Through some error one craneman allowed the bottom of a ladle to rest upon some object on the floor, with the result that it swung suddenly around and tore the control wheel from the grasp of the man who was pouring. This allowed the metal to splash as the ladle swung from side to side, and immediately a column of flame drove the craneman above from his cage. However, a sprinkler head was touched off, and the descending column of water protected the men and allowed them to approach and reach the ladle wheel. Another workman climbed to the crane cage, and while others stood and threw water over the workman handling the ladle, he stood on boards hurriedly thrown upon the metal upon the floor and completed the pouring. The casting was saved.

In the four-story pattern storage building adjacent to the main foundry building are stored thousands of patterns for the great variety of machines which this company has built. Here, too, the sprinkler system confined an incipient fire to one shelf section not over 20 feet square, where the entire building was jeopardized.

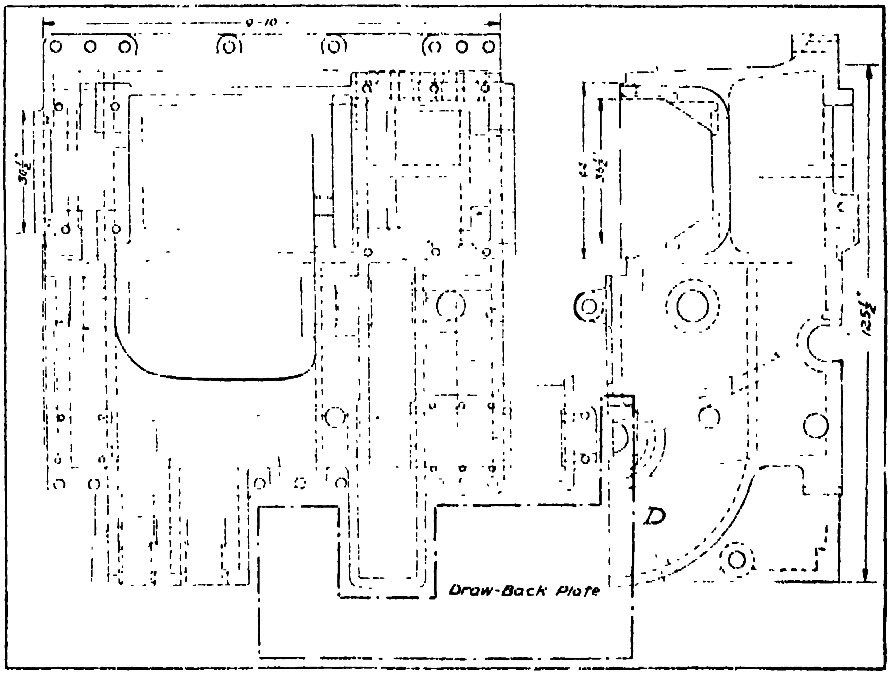


FIG. 12 PLAN AND SECTIONAL VIEWS OF THE HEADSTOCK CASTING WITH THE AREA INCLUDED IN THE DRAW-BACK INDICATED

The Lincolnville Mfg. Co., Lincolnville, Kans., are preparing to build a foundry to manufacture castings for an air-craft motors as well as other gray-iron castings.

Suggested Improvements on Converter Wind Box

Changes in the construction of the wind box on side blow bessemer converters as shown in the accompanying illustrations have been made the subject of a patent by Albert Rom-

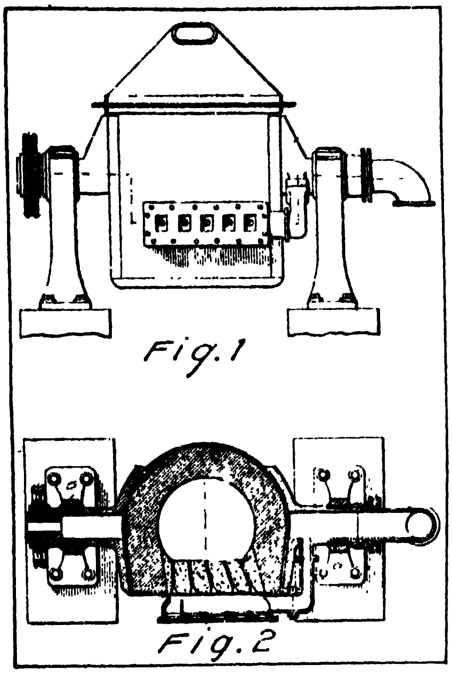


FIG 1—SIDE ELEVATION OF THE DEVICE FIG. 2 SECTION OF FIG. 1 ON CENTER LINE OF TRUNIONS SHOWING ANGULAR POSITION OF THE TUYERES

melaere, South Vancouver, British Columbia, Canada.

The objects of the invention, as claimed by the inventor are: (1) To provide a converter of this type with a wind box having a knockout back. This is accomplished by cutting away the shell of the vessel the full area of the inside of the wind box, thus providing a space whereby the refractory lining may easily be removed or replaced. (2) To provide a wind box having a number of tuyeres leading therefrom, these tuyeres being arranged at different angles with respect to one another so as to produce a rotary movement of the contents of the converter, by means of which different portions of the molten bath are brought successively under the oxidizing action of the air blast, thus providing a uniform distribution of the air and preventing over oxidation of molten contents at any one portion. (3) To provide a wind box with openings or peep holes so arranged that the contents of the converter may be viewed through the tuyeres without necessitating the suspension of the blowing operation or the tilting of the converter and the removal of the cover. (4) To provide for the removal of obstructions in the tuyeres. This is accomplished by means of doors in the wind box cover through which a rod may be thrust to clear the obstruction. The doors open inwardly and therefore the internal pressure normally tends to keep them closed tightly thus preventing leakage.

Organize New Export Corporation

For the group development of the foundry equipment export trade under the provisions of the Webb act, the Foundry Equipment Export Corp. has been organized to engage in the sale of all kinds of foundry supplies, equipment and accessories required by casting manufacturers. The corporation has been incorporated under the laws of Delaware with a capital of $50,000. A temporary office has been established at room 114, 40 Wall street, New York. The following companies are stockholders of this export corporation:

American Foundry Equipment Co., New York, sand cutting machines and sand blast equipment.

Grimes Molding Machine Co., Detroit, molding machines.

Arcade Mfg. Co, Freeport, Ill., molding machines.

American Molding Machine Co., Terre Haute, Ind., molding machines.

S. Obermayer Co., Chicago, foundry equipment and accessories.

Buch Foundry Equipment Co., York, Pa., molding machines and foundry accessories.

National Engineering Co., Chicago, sand grinding equipment, grinding pans, etc.

E. J. Woodison Co., Detroit, molding machines and foundry supplies.

Whiting Foundry Equipment Co., Harvey, Ill., sand blast equipment, cleaning room machinery, furnaces, cupolas, etc.

J. W. Paxson Co., Philadelphia, sand blast machines and other foundry equipment.

Officers of the Foundry Equipment Export Corp. follow: Col. T. S. Hammond, Whiting Foundry Equipment Co., president; L. L. Munn, Arcade Mfg. Co., first vice president; E. J. Woodison, E. J. Woodison Co., second vice president; V. E. Minich, American Foundry Equipment Co., treasurer, and S. T. Johnston, S. Obermayer Co., secretary. The executive committee consists of R. S. Buch, Buch Foundry Equipment Co., V. E. Minich, G. L. Grimes, Grimes Molding Machine Co., S. T. Johnston and the president. Alba B. Johnson Jr., Morris building, Philadelphia, has been engaged as manager of the corporation. After completing an initial survey of the products manufactured by the stockholders, he will go to Europe where headquarters probably will be established in London and from which European operations will be conducted.

Collapsible Core Prevents Cracking Castings

By H. E. Diller

Question—We are making a number of cast-iron rings which must be chilled on the inside. In making these rings we have used an iron core. This chills the iron satisfactorily but the rings all break owing to shrinkage. Please tell us how to get the chill without cracking the casting.

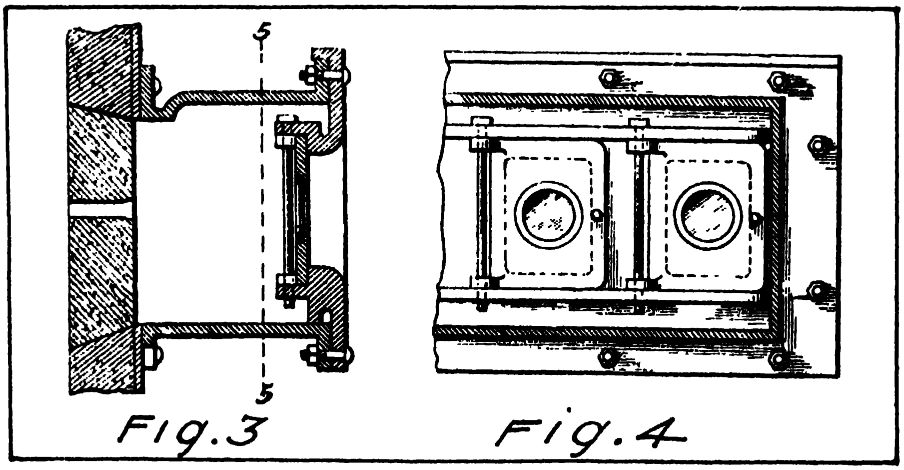


FIG. 3—SECTION AND DETAIL OF WIND BOX FIG. 4—DETAILS OF DOORS SHOWING THE ARRANGEMENT OF PEEP HOLES

Answer—We would recommend that you use collapsible iron core with arrangements for withdrawing the core as soon as the metal in the casting is set. A few trials along this line will soon establish the length of time which should elapse before removing the core.

Copper Diffuses Through Cast Iron

Annealing Experiments With Copper Oxide Packing Show That Copper Penetrates Into Malleable Iron—Gray Iron Affected Differently—Graphite Changed So That It Appears Like Temper Carbon

BY H. E. DILLER

IN experimenting to ascertain the effect of different oxidizing packings on annealing malleable iron a bar was packed in copper-oxide packing and annealed at 1000 degrees Cent. When the bar was taken from the furnace it was found that the copper oxide had been reduced to metallic copper and melted and that it had penetrated into the iron. An average sample of the bar showed that the carbon had been reduced from 2.70 to 0.60 per cent and there was 21.4 per cent copper.

A micrograph of this bar showing black blotches of copper all through it is seen in Fig. 1. A test showed a strength of 68,200 pounds per square inch and an elongation of 1 per cent in 2 inches. It was thought that the high percentage of copper would materially increase the conductivity of the metal but this was proved to be not so by a test which showed the resistivity was 17, which is approximately 10 times that of annealed copper.

Some time after this first experiment other tests were made of a similar nature. In the second trial, however, the test pieces were packed in 3-inch pipes with black copper oxide and the pipes were placed on top of the pots in a regular annealing furnace. The pyrometer in the furnace did not register above 925 degrees Cent. but the copper oxide was reduced and the copper fused together, although it had not been completely melted.

In the second experiment the bars were heated approximately 100 degrees

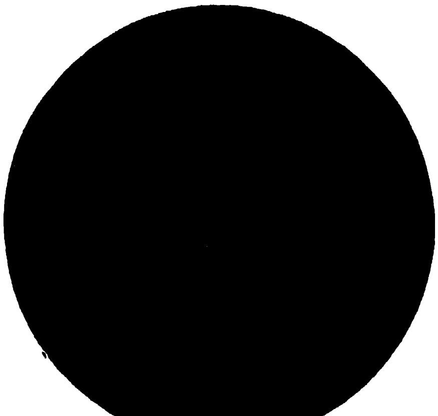


FIG. 1-MALLEABLE IRON CONTAINING MORE THAN 20 PER CENT COPPER

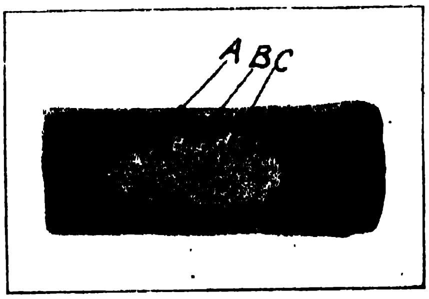


FIG. 2—CROSS SECTION OF MALLEABLE BAR ANNEALED IN COPPER-OXIDE PACKING

Cent. lower than the temperature reached in the first experiment and the results were somewhat different. When the bars were cut cross-wise at different places no copper was noticeable except in the center near the middle of the bar, and close to the edge all over the bar.

Fig. 2 shows the cross-section at the middle of a bar. Fig. 3 is a micrograph taken at the outside edge of the cross-section. The dark portion in the upper part is copper. The white at the bottom is ferrite and the dark places toward the center are pearlite. The band of lighter material is a heterogeneous mixture of cementite, pearlite and ferrite. The structure here is more like a complicated high-carbon steel than like malleable iron.

The dividing line between the areas *A* and *B*, Fig. 2, is shown in Fig. 4. The white portion is copper and the dark particles are iron. It can be seen from this micrograph how thoroughly the iron and copper are knitted together. Some iron particles were distributed through the copper just as some of the copper penetrated into the casting.

The structure of section *B*, Fig. 2, is similar to that usually found in malleable iron. No particles of copper were found in it. In the area *C* just inside of the section *B* there are a large number of small copper areas in a matrix of high carbon steel. In this area occasional patches of white ferrite are found. One of these patches of ferrite is shown in Fig. 5 which also shows the copper scattered through the dark matrix. As the copper color does not show in the illustrations as it did to the eye under the microscope, so the micro-

Abstract of a paper presented at the Philadelphia meeting of the American Foundrymen's association, Sept. 29-Oct. 3. The author, H. E. Diller, is associate editor of THE FOUNDRY.

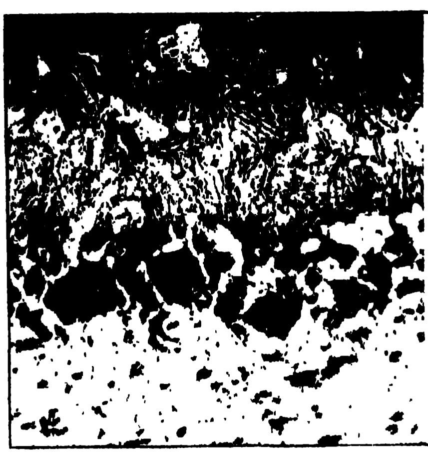


FIG. 3—OUTSIDE EDGE OF BAR SHOWN IN FIG. 2

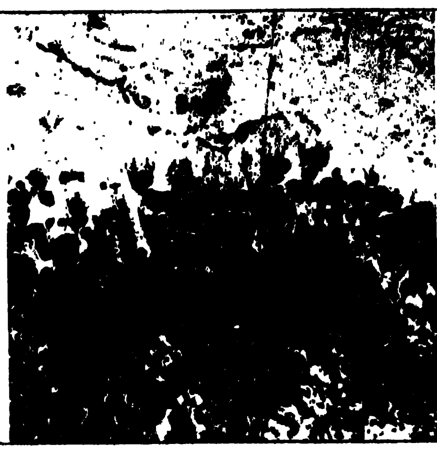


FIG. 4—DIVIDING LINE BETWEEN *A* AND *B*, FIG. 2

FIG. 5—CENTER OF BAR SHOWN IN FIG. 2

graphs do not bring out the copper as clearly as a direct view of the sample would do.

The effect of copper oxide packing on the malleable iron bars created a desire to find out what influence it

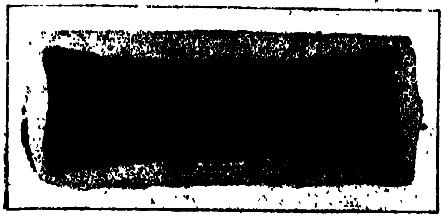


FIG. 6—CROSS SECTION OF GRAY-IRON BAR ANNEALED IN COPPER-OXIDE PACKING

would have on gray-iron annealed in it. Therefore gray-iron bars the same size as the malleable bars which were treated were packed and annealed in the same way as the malleable bars.

The results were quite different in the case of gray iron than in the case of malleable iron. This is illustrated in Fig. 6 which shows a cross-section of one of the bars. Three distinct areas can be seen. The area *A* contains all of the copper. There is a thin layer of copper on the outside and next to this the copper is very finely divided and is in the form of drop-like areas surrounded by a matrix of iron. This matrix has a peculiar structure and is more like steel than it is like gray iron. The line between *A* and *B*, Fig. 6, is shown in Fig. 7. The dark area is the portion containing the copper. The light portion in the same figure represents the structure of the section marked *B* in Fig. 6. The same structure is seen in the upper section of Fig. 8, which is part of the dividing line between areas *B* and *C*. This structure is almost like the structure of malleable iron in its appearance under the microscope, but scattered through it can occasionally be seen flakes of graphite.

The center of the bar *C*, Fig. 6, has the structure of unchanged gray iron. This is shown in the lower section of Fig. 8.

W. E. Ruder of the research laboratory of the General Electric Co., Schenectady, N. Y., who made the micrographs for this paper, said in regard to the changed structure of the gray-iron bar: "The only explanation which I can give for the peculiar structure shown is that the entire material up to the dividing line between *A* and *B*, Fig. 6, was in a semimolten condition, and while in this condition the copper oxide became mixed with it and the oxygen was given up by the copper and united with the graphite. The changing of graphitized carbon to temper carbon in section *B* is very unusual and until this experiment I did not think that this change could be brought about short of actual fusion."

Chain Belt Co. to Build New Plant

Plans of the Chain Belt Co., Milwaukee, whose stockholders recently voted to increase the capital stock from $1,000,000 to $2,800,000, contemplate the ultimate evacuation of the plant at Sixteenth and Park streets, and its removal to a 23-acre site at Thirty-ninth and Orchard streets. Building operations are to progress by departmental units as rapidly as business conditions, removal difficulties and other considerations will permit.

The first unit to be erected will be a brick and steel structure, 150 x 316

FIG. 7 DIVIDING LINE BETWEEN *A* AND *B*, FIG. 6

feet, to house the concrete mixer assembling department. The plans and work for this as well as for the entire project are under the supervision of Frank D. Chase, Inc, Chicago. The new assembling plant will be among the best lighted and ventilated factory buildings in the city.

C. W. Levalley, the founder of the company, served as president until 1916 when he retired to become chairman of the board. He died in 1918 at the age of 84 and was succeeded as president by William C. Frye. Mr Frye joined the company at the age of 17 and is the oldest employe in continuous service. He is actively interested in a number of other companies and holds executive positions in a number of allied interests. He is secretary and treasurer of the Sivyer Steel Casting Co., vice president of the Federal Malleable Co., and a director of the Electric Steel Casting Co., Chicago.

C. R. Messinger, vice president and general manager of the Chain Belt Co., is also vice president and general manager of the Sivyer Steel Casting Co., secretary of the Federal Malleable Co., and a director of the Electric Steel Co.

Other officers of the Chain Belt Co. are W. C. Sargent, secretary, who was elected in 1900, and is also treasurer at the Federal Malleable Co., and C. L. Pfeifer who has served as treasurer of Chain Belt Co. since 1916, having previously occupied a position as comptroller. Donald Fraser, for many years vice president of the company, is now consulting engineer. He is also second vice president of the Sivyer Steel Casting Co. and Federal Malleable Co.

Suitable Cylinder Iron

By H. E. Diller

Question:—I have taken a position with a foundry making automobile cylinders and would like to know what composition of iron is being used in cylinders by the leading automobile manufacturers.

Answer:—There is a considerable range in the composition of cylinder iron made by different foundries. Most of them make iron which will fall within the following limits: Silicon, 1.75 to 2.75 per cent; phosphorus, 0.150 to 0.300 per cent; manganese, 0.40 to 0.90 per cent and sulphur under 0.10 per cent.

The analysis is not the only thing to be watched in iron for cylinders. Some firms use 10 to 20 per cent charcoal pig iron in their mixtures, while other firms use all coke pig iron. It is also important that the cupola be properly slagged, and to do this 50 pounds of limestone and 2 pounds of fluorspar should be used per ton of iron melted.

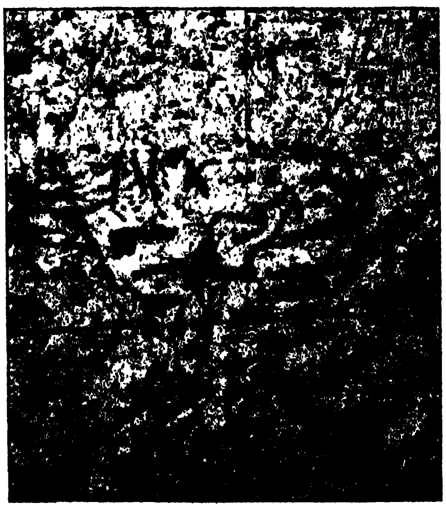
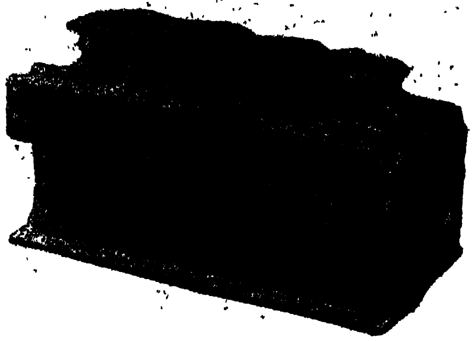
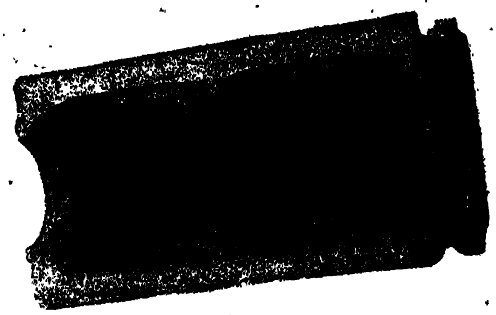


FIG. 8—STRUCTURE OF *B* AND *C*, FIG. 6

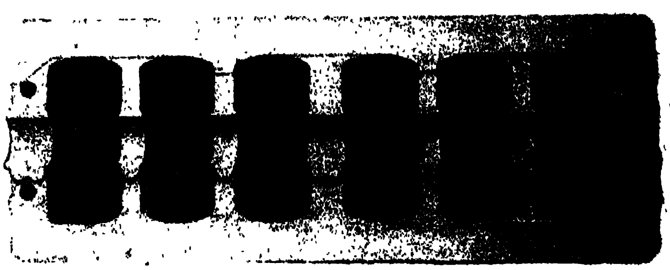
Under differing conditions the amount of fluorspar may have to be varied. You can find out the proper amount to use by watching the cupola, and if an undue amount of slag remains around the tuyeres when the bottom is dropped, or the iron loses an excessive amount of silicon cut down the fluor spar.

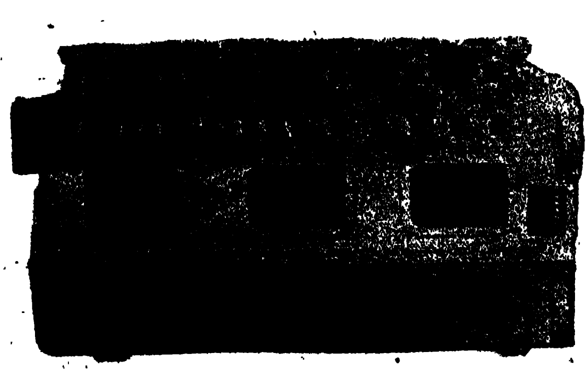
Aluminum Crankcases Made in England



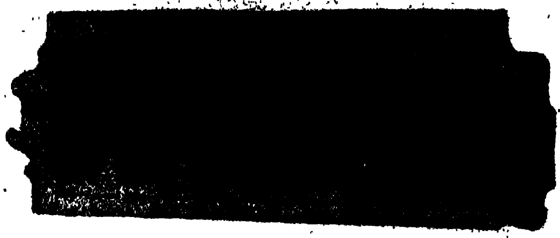


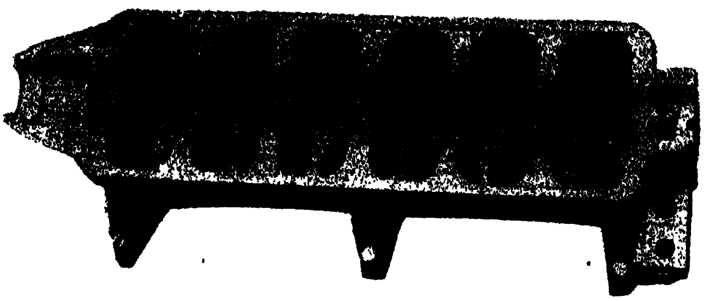
THE various types of aluminum crankcase castings shown in the illustrations on this and succeeding pages were made at the plant of Rowland Hill & Co., Coventry, England They may be said to typify in a certain way the result of the insistent demand for war time production. The automobile industry was the first factor to promote the use of aluminum in machine and engine design, but the war accelerated its use to an unprecedented degree. Motor trucks, lorries, cars of all descriptions, sea planes, airplanes, oilburning engines on submarines and destroyers, all did their bit in creating new uses for and promoting demands for equipment made from the lightest of metals. In common with the engineers of other countries the best brains in the engineering profession in Great Britain were devoted to the problem of designing improved methods and equipment for motor propelled vehicles. They felt that they



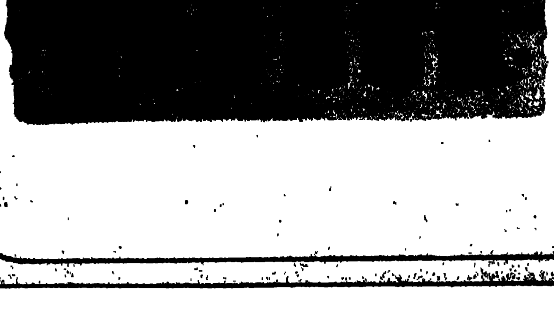


Quantity Production on Aluminum Crank-

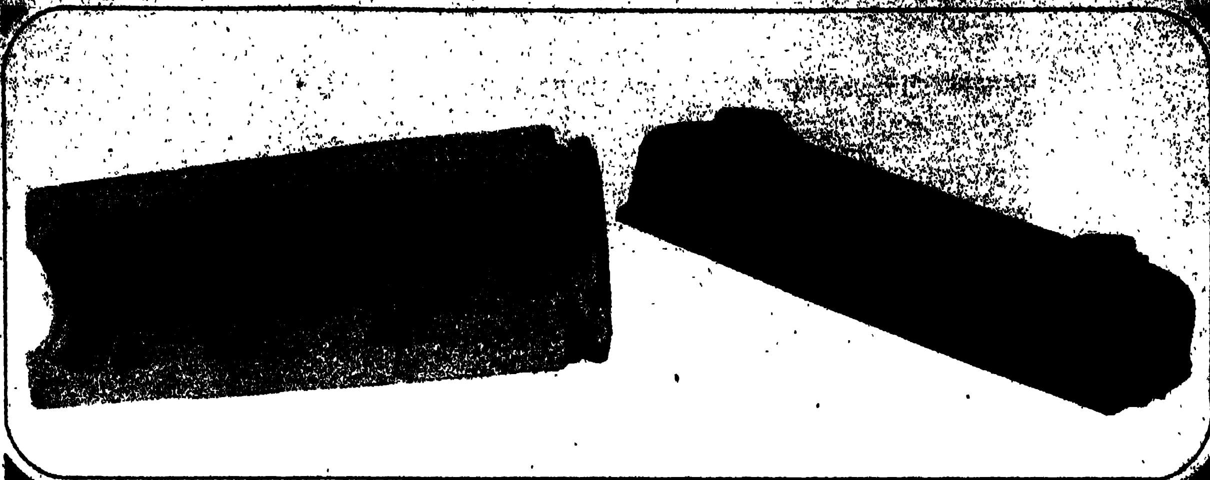




not only had to uphold and maintain Britannia's ancient glory as mistress of the seven seas, but they saw no reason why they should not make a bid as well for supremacy on the land and in the air. The measure of success which they achieved in this laudable ambition during the past four or five years shows that they have reason to be proud of their efforts. The impression seems to prevail on this side of the Atlantic that British designers of engines and machinery in general, confine all their efforts to the features of strength, ruggedness and simplicity. While it is true, in the main that staunchness is a leading characteristic of both the British people and their products, still a glance at the accompanying illustrations should be enough to convince any person that for beauty of design and mechanical perfection these castings compare favorably with those made by any of their competitors in any part of the world.

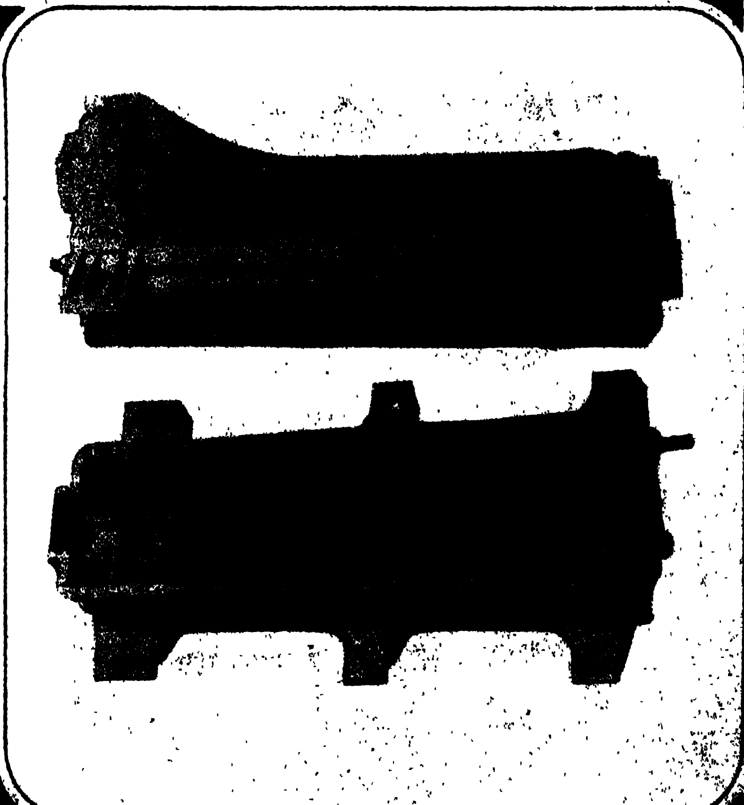


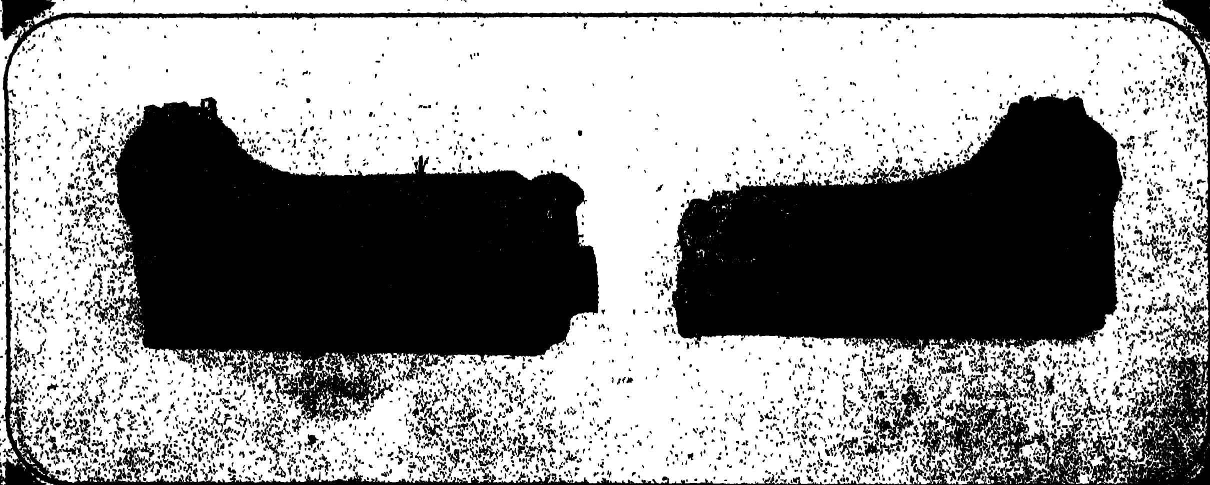
cases Secured by Standard Equipment



Examples are shown of four, six and twelve-cylinder crankcases. The lower halves in each instance have been made in green sand; while the upper halves have been made half green and half dry. The patterns for the upper halves of the four and six-cylinder crankcases were split longitudinally and the casting poured on its side, one large dry-sand core forming the complete interior. The 12-cylinder crankcase was molded with the convex side up. The interior was formed with a series of separate cores which however fitted closely together when in place. Each end of the pattern consisted of a core print the full size of the end. When the pattern was drawn a core having all the necessary bearings, bosses and recesses was dropped into each of these prints.

The machining strips on the ends of the lower half of the crankcase pattern were loose. They were drawn in separately after the main pattern had been removed from the sand.





How and Why in Brass Founding

By Charles Vickers

Fluxes to Cut Slag

We would like to learn of a flux that can be used in open-flame furnaces to cut the slag and metal off the lining. We have used lime, also glass bottles with fair results.

There are a number of fluxes on the market that are good for the purpose mentioned and samples can be obtained from the advertisers in THE FOUNDRY upon request. It would probably be easier to purchase a flux already made than to make one up. If it is preferred to make the flux, the following mixture is good for the purpose. Fluorspar, 1 part; fine hard coal, 1 part; lime, 3 parts If not sufficiently liquid, the lime can be decreased.

Melting Brass Turnings

We would like to know what is the best method to follow in melting brass turnings.

The best way to melt brass turnings is to first melt a small amount of ingot metal. Get the molten metal hot, then dissolve all the turnings possible, using charcoal as a cover for the metal. As fast as the turnings melt and get hot, more should be filled in, until the pot is filled with metal, at which stage a pound or two of phosphor bronze scrap should be added as a deoxidizer. If the turnings are from phosphor bronze, this last addition is not required.

The Casting of Copper

We require a number of copper castings of a special nature in that they must be very much more dense than ordinary cast copper which usually is very porous and of open texture. The castings we require must be of the same closed grain as copper that has been rolled. Can you inform us of any article or book treating of this subject, especially the casting of copper under pressure?

We would like to learn of makers of suitable machinery for producing large copper castings of the nature we have outlined.

We doubt the possibility of so treating copper that it will make castings of the same texture as rolled sheet as it is the working of the copper in rolling that breaks up the crystals and closes the grain of the metal. Putting pressure on the molten metal might cause it to fill out the mold better, but would not affect the grain size. The nearest approach to the effect desired is obtainable by chilling the metal, as this acts to prevent large crystal growth. Copper is densified by chilling and this could be accomplished in the case of these castings by casting them in a graphite mold. The copper will cast in this material, but it would be necessary to introduce the molten copper into the mold by means of a large number of gates, so located that the metal would not have to run far in the mold, otherwise it would chill and fail to run the casting. The core, if the casting uses a core, should be also made of a heat conducting material.

This is perfectly feasible, but the matter would require careful study to make the mold to part properly, to distribute the gates so as to run the casting, to feed the shrinkage of the casting and avoid cracking. The only machinery used in making copper castings, is the rotating metal mold used in making shell bands by the centrifugal method.

Facing Sand for Bronze

We would like to procure a formula for a good facing sand for molding bronze gears weighing about 100 pounds. The castings are made in green sand.

It is not necessary to use a special facing for a bronze casting of 100 pounds weight unless the sand ordinarily used is fine in character. When the sand is too fine the use of a facing will obviate difficulties from scabbing, and blowing. The facing should be free venting so the metal will lie against it without any simmering, and thus produce a sound, clean casting. The following facing mixture can be relied upon to fulfill these requirements: New molding sand, 10 parts; fine silica sand, 5 parts; ground clay, 1 part. Mix these together thoroughly. If a mill is used the facing will be tougher. In the absence of a mill, throw the facing upon the floor and tread it well to mix it. The clay should be fire clay without any grit; a fat clay is best. Ordinary clay may be used, but the best grade is china clay. Silica sand is better than lake, or sea sand and should be used. In its absence use a sharp sand.

Gear Blank Mixtures

We would like to have a couple of formulas suitable for making gear blanks, the teeth being cut by machine.

The following alloy makes a good gear bronze as it develops no hard spots: Copper, 88 per cent; tin, 11 per cent; 15 per cent phosphor copper, 0.5 per cent; zinc, 0.5 per cent. The average brinell number of the above alloy is 79, the range being 76 to 80. Another good mixture consists of copper, 86 pounds; tin, 10 pounds; nickel, 3 pounds, and phosphor tin, 1 pound.

What is Duralumin?

We would like some information regarding the metal known as "duralumin" We would like to know just what it is composed of and how it is handled in making castings.

"Duralumin" is an alloy of aluminum, copper, manganese and magnesium. It is not supposed to be a casting alloy, being used almost entirely for rolling and drawing purposes. It can be made as follows: Aluminum, 95.50 per cent; copper 2 per cent; 30 per cent manganese copper, 2 per cent, magnesium, 0.5 per cent.

Melt 2 pounds of copper and 2 pounds manganese copper, and add 4 pounds of aluminum, then ingot. Use this as a hardener by melting 91.50 per cent of pure aluminum ingot with 8 per cent hardener, and when liquid add 0.5 per cent of magnesium. The metal will make sand castings, but it will not be as good for this purpose as an alloy of aluminum 92 per cent, copper 8 per cent.

Holes in Phosphor Bronze

We would like information in regard to the best method of producing phosphor bronze castings without pin holes.

Pin holes in phosphor bronze castings are caused by the metal absorbing gases while it is being melted, and possibly the sulphur from the fuel plays an active part in producing this condition. The metal should be protected while in the furnace and a flux of bone ash, or acid phosphate, white sand and charcoal is useful as a cover. If melted with care no trouble will be experienced from pin holes in phosphor bronze.

Castings for Ship Construction—XIII

Constructing a Double Shaft Bracket Presents Many Difficulties in Patternmaking—This Type Differs Essentially From Others Except in the Barrel Patterns

BY BEN SHAW AND JAMES EDGAR

THREE types of shaft brackets have been considered in previous articles of this series. Yet another type commonly used differs both from the patternmaker's and molder's point of view from those considered. In this bracket the box center rests on a platform of a stern frame. It may be observed that there are two castings joined on the center of the middle box but frequently both the port and starboard brackets comprise one casting even in this type. The single casting has the usual advantage of greater stability or rigidity but it also has disadvantages. If an accident occurs to one bracket, and it is not often that both sides are injured at one time, it is much cheaper to replace a single bracket than a double one. Apart from the cost of the casting there is additional labor involved in removing and replacing plating, etc. However, whether the brackets are designed as one casting or as two the patternmaker's work is not essentially different except that the single pattern being larger is more difficult to handle after it is made. No coreboxes are necessary for this job as it is easier to make the cores in place, the boss core being made as usual with a board. The two table cores as will be seen in Figs. 1 and 2 are separated by a rib, but they are not detached from the arm by a wall of metal extending to the first rib of the arm. Sometimes there is a wall of metal between. In this bracket the included angle is constant from back to front of the tables but this is not always the case. When the angle at the back differs from the angle at the front the work is complicated, for if there is a dividing wall of metal between the table and the arm the patternmaker has to deal with what is called a twisted face. This causes more labor in making the flanges *A* and *B*, Fig. 1. Details for brackets such as are usually supplied by the drafting room are given underneath the working drawings, and it is usually necessary to refer to the drawing of the stem post to get details of frames and plating. With these particulars and the templates from the molding loft, the patternmaker can start work. Templates like Figs 4, 5 and 6 usually are supplied with any additional to those on the drawing noted on the templates.

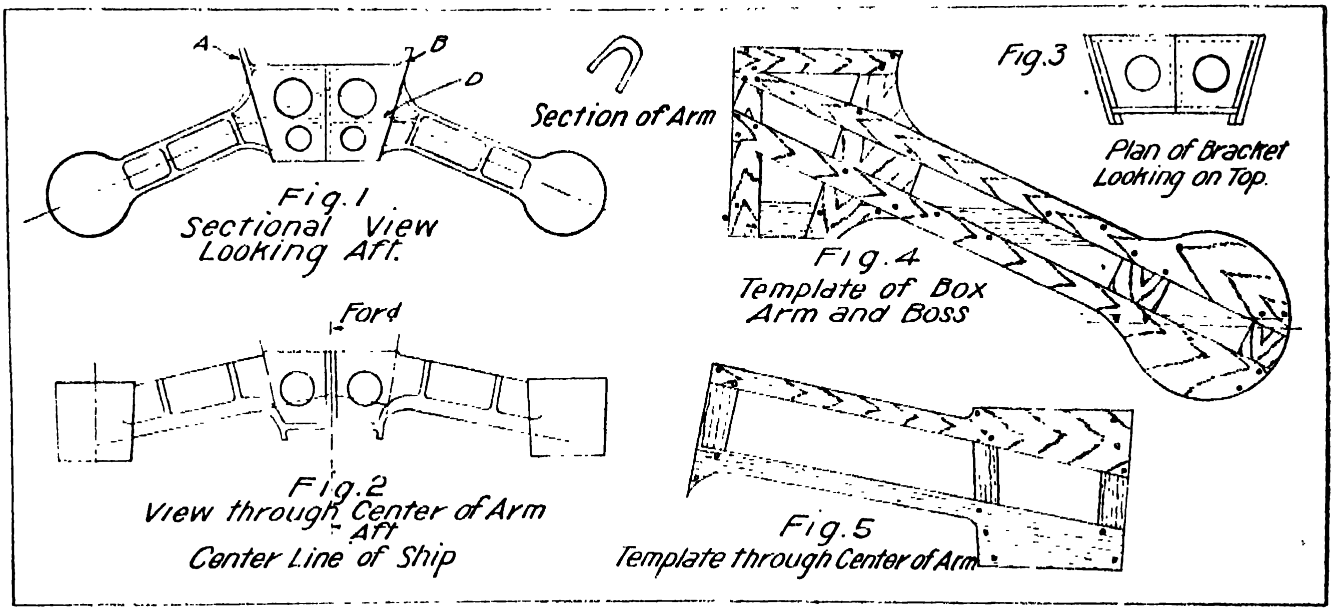


FIG. 1—SECTIONAL VIEW OF DOUBLE SHAFT BRACKET. FIG. 2 VIEW THROUGH CENTER OF ARMS OF DOUBLE SHAFT BRACKET FIG. 3—PLAN OF BRACKET FIG. 4- TEMPLATE FOR BOX, ARM AND BOSS FIG. 5—TEMPLATE FOR CENTER OF THE ARM

Barrel is Similar

In the previous articles on brackets barrels have been so fully discussed that it is not necessary to say much here except to urge care in building. Before the lagging is fastened on, the framework should be set to center lines and plumb used. The usual arrangements should be made in the barrel for guiding the drawbolts. After the pattern is finished it is wise to screw a thick hardwood bar across the underside of the barrel on which the iron tapped plate can be screwed. This is especially valuable if the barrel is long because the strain of drawing it out of the sand is great, and unsupported the rings or lugs may break.

The three different methods of making large plates may be used to advantage in this work and the relative merits and advantages of each are readily understood. When building the patterns it is well to set down lines on the floor, just as if one large pattern is wanted, allowing of course for ½ inch of machining on each of the joint plates. These joint plates would be made the total length of the table, the end plates fitting in between, and they would sit on the bottom plate, the bottom plate of the patternmaker being the top plate in the mold. It is advisable that the plate which will be the molders top should cover the edges of the joint and end plates, but the bottom plates should be made to the inside sizes so that when the molder has made the cores and withdrawn the joint and end plates, the bottom plate can be withdrawn readily without tearing the sand.

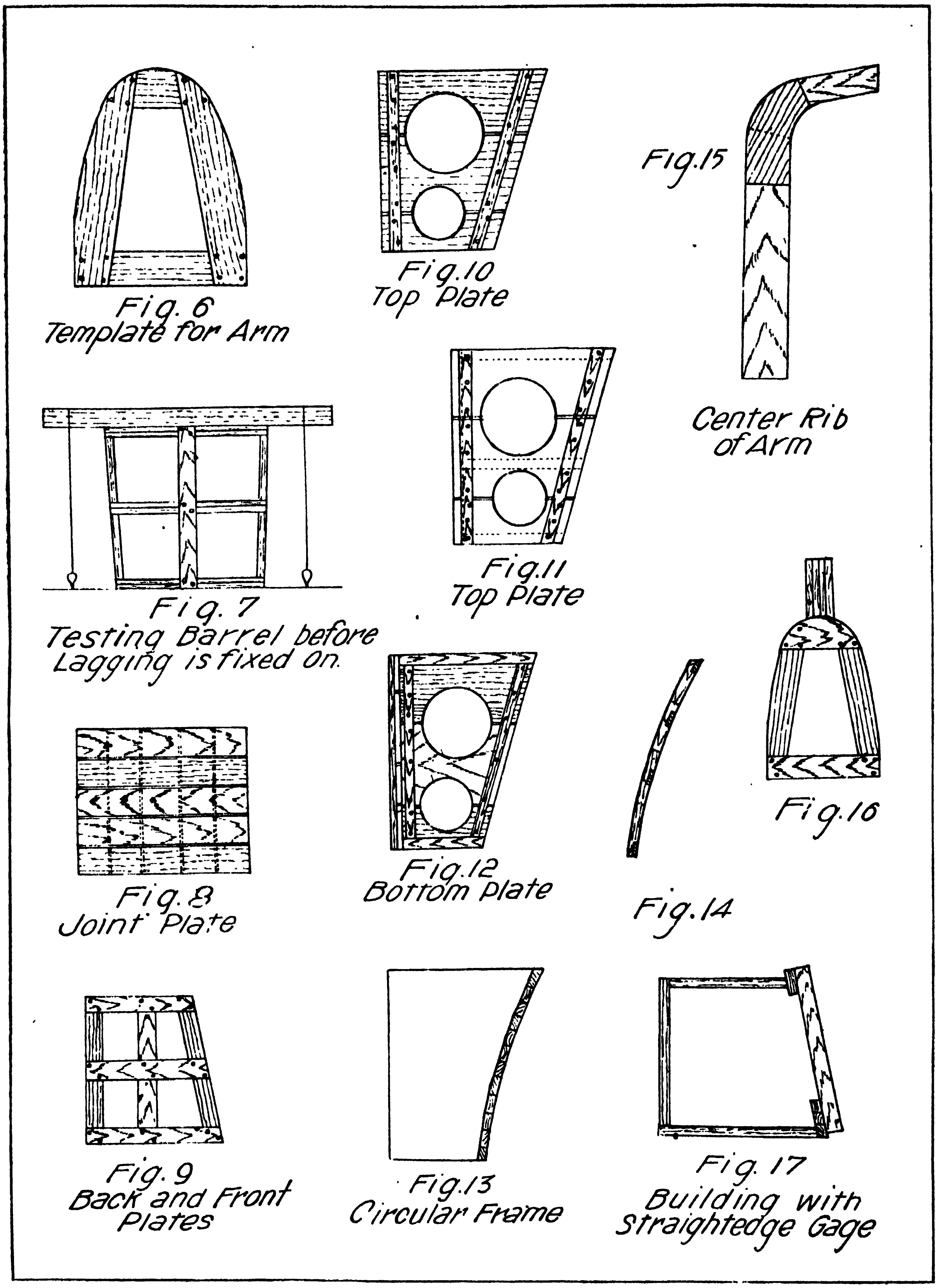


FIG. 6—TEMPLET FOR ARM FIG. 7—TESTING BARREL FOR ACCURACY BEFORE AFFIXING LAGGING FIG. 8—JOINT PLATES FIG. 9—BACK AND FRONT PLATES FIG. 10—TOP PLATE FIG. 11—TOP PLATE FIG. 12—BOTTOM PLATE FIGS. 13 AND 14—CIRCULAR FRAMES FIG. 15—CENTER RIB OF ARM FIG. 16—SECTION OF ARM FIG. 17—TRYING OUTER FACE WITH STRAIGHTEDGE

It is well to make the joint plates of two thicknesses as shown in Fig. 8. An open frame could be made but if the end plates are open framed and the molder's top plate has circular holes cut through, the molder has access for ramming up the cores. Whether the joint plates are made of two thicknesses or framed is not material, but it is essential that the center wall of metal *D*, Fig. 1, should not be open.

There are holes through the wall, and it is as well to draw the holes on the plate as a guide for the molder, so that he can draw center lines on one of the large cores and fix on the circular cores. The back and front plates being ordinary half lapped frames like Fig. 9 require no explaining except that like all half lapped plates the joints should be easy to allow for possible swelling of the timber in the mold. The molder's top plate is shown in Fig. 10. Plates with holes in them are usually made open jointed with narrow battens inset to prevent them warping and for convenience in cutting the holes. These are the only recommendations for this method, because they usually shrink too much. Different widths can be screwed together, and after being drawn off each width can be removed and the hole cut with the bandsaw.

Building the Pattern

When all the plates have been finished, the tables may be built in their correct positions on the floor. As was said previously it is nearly always best to build brackets as they will be in the ship. In the case of this bracket however this method would be awkward. A support would have to be made for the center tables and a saddle rest for the barrels, which presents no difficulty but it would be awkward and inconvenient when building the arm, and would consequently take much time. To simplify building the arms, it is better to build with the center table resting on the floor and the barrels in a perpendicular position as shown in Fig. 19.

In building the tables it should be remembered that the molder will have to unscrew them, and all screws should be inserted so that when the pattern is turned upside down he will be able to reach them easily. Thus the bottom plates should be laid on the floor first and temporarily screwed down. The center plate next should be set on and temporary pocket screws inserted. These screws will have to be taken out and replaced by screws through the bottom plate, the molder's top plate that is, prior to sending the job to the foundry. The end plates may be put into position next and blocks, or buttons as they are sometimes called, about 1½ inches square placed inside for fastening them. The plates are heavy, the metal section usually being 2 inches, or 2½ inches, and if the plates are not well screwed when the work is lifted from the floor, the table will not be as rigid as it should be. It is not possible to put in the center ribs until after the arms are finished as they are fitted to the inside shape of the arm. For the circular holes on the ends of the boxes and on the bottom plate, it is as well to put on prints. Figs. 11 and 12 are views of the finished table looking on the top and bottom respectively.

If there was a dividing wall of metal between the tables and the arm, a two-thickness plate would answer the purpose well; but if the face was twisted owing to the angles of the top and bottom being different, it might be necessary to use narrow widths as shown with the circular face in Fig. 13. With narrow widths no shaping would be required. It is quite common to have a circular instead of a straight face, and if it is not twisted a frame should be used. Half lapped frames for arcs or circles seldom are made in the patternshop, and yet it is good practice and if properly and carefully made will be more reliable than an ordinary straight half lapped frame. Fig. 14 is a view of such a frame. The arc rails unless the frame is small indeed, should be built of segments in about three courses. They should be built wide to allow for finishing afterwards. The straight rails are made in the ordinary way, the necessary convex shape being given to the checks. Even if the radius at the bottom of the frame is different from the radius at the top it does not affect the construction of the frame.

The construction of the arms is a big job. The channel type of arm involves more labor and takes more wood than the fishback type. A great quantity of lumber is unavoidably cut to waste. It is possible to core out these arms, but there would not be a gain of any kind by doing so, at least as much and probably more timber would be used on the pattern and the corebox would be additional. Furthermore, the labor cost would be greater in the coreing process and there would be more uncertainty about thicknesses. There are conceivable circumstances in which a block pattern and corebox might be superior, but almost invariably a shell pattern is best, as with all large shipwork boldness of execution is necessary. Craftsmen with confidence and judgment can have the work done, before perhaps equally skillful but more timid craftsmen have started. Touch and sight are the indispensible tools.

The segmental method should be employed when building the channel arms. It is not possible to use lagging because lugs inside would be inadvisable from the molder's point of view, and there would be the added difficulty of working from the straight part of the arm to the large fillets which connect the arms with the box.

It will be obvious that a platform of some kind is necessary on which to build the arms. Sometimes when there is a dividing plate between the center table and the boss it is more convenient to make the arms by themselves and afterwards fit them into position. This enables more men to be employed on the job. However, when the arms practically form part of the table they cannot be made separately. A suitable building platform is shown in Figs. 19 and 20. Any mistake in the angle will spoil the arms, as it will be quite impossible to rectify it afterwards. The platform must be strongly made, because the weight of the arms which they will have to support will be great. If the arms are divided by cross ribs they may be made and placed in their correct positions on the platform.

Details of the Arms

Pieces like Fig. 15 are needed and should be built of a few thicknesses making five or six inches over all. They should be fitted carefully between the barrels and the center table. When they have been bedded down on the straight edges, they may be removed and planed through with a round-bottom plane. The sides of the arms are built in horizontal layers. Fig. 18 is a section through a finished arm. The widths of each layer are different and have to be taken from the drawing board on which the courses are marked. There is always a tendency to grow when many courses of segments are used and thus the thickness towards top of the arms may not be what it ought to be unless care is taken. It is possible to draw each segment geometrically, but it is more of a task than cutting the lumber to an approximate shape, setting it in its position, drawing it off and finishing. It is not a simple matter to shape these arms. The inside is much more difficult than the outside, because it cannot be seen so readily. The large curves or fillets should remain approximately the same radius, falling over towards the tops of the arms. The best practical way of getting a good shape is to try a bending lath on the surface when each course is laid down. The lath shows little discrepancies and irregularities of the surface.

The lath is an invaluable tool. It should be only about ¼-inch square and whatever length is necessary, and made from straight grained timber. Pine if it is well seasoned makes a good lath, and when a good one is obtained it should be taken care of. The real test of this simple but invaluable tool is when it is bent on various shapes and yet when released springs back straight.

If there are any kinks in it, it should be cast aside as worthless.

Looking at Fig. 1 it is seen that the fillets on one side of the arm project beyond the end plate of the table forming flange *B* and *C*. These flanges are important on the outer faces because the plating is riveted on them. The best way to keep this outer face correct is to use a straight edged gage such as is illustrated in Fig. 17. This is simply a straightedge long enough to bear on the top and bottom plates. At the top a piece *A* of the same thickness should be screwed to the edge.

The arms must be well secured both to the barrels and to the table. As the segments will be 2 inches or 2¼ inches thick it is necessary to screw some lumps and hollows and for this reason the segments should be left about ¼-inch wider on the bend, so that the metal at the finish will not be thin. To finish the inside of the arms, it is best to unscrew them and lift them off the platforms together. Bore holes and drive in pegs from the outside the same length as the required thickness. The craftsman knows that when he touches these pegs he can go no further.

The flanges on the top of the center table, which are really a continuation of the arm metal, present no difficulties if the edges of the top and bottom plates of the table are on the same plane. However, if they are not on the same plane, pieces of thick lumber may be planed to the nearest angle and barrels or supports from falling away from the arms when the patterns are lifted from the building floor. It probably is safer to send the barrels to the foundry separately, where the pattern may be erected as it will go into the sand. For this purpose the careful craftsman will make a support for the center table as the barrel will rest on the floor.

Constructing the arms that join a division plate is similar, except that instead of cutting the center rib so that lumber may be carried right across, blocks may be fitted or segments at right angles to the other courses of segments and joining the center rib piece. The finish of the fillets on the division plates should be screwed on as separate pieces

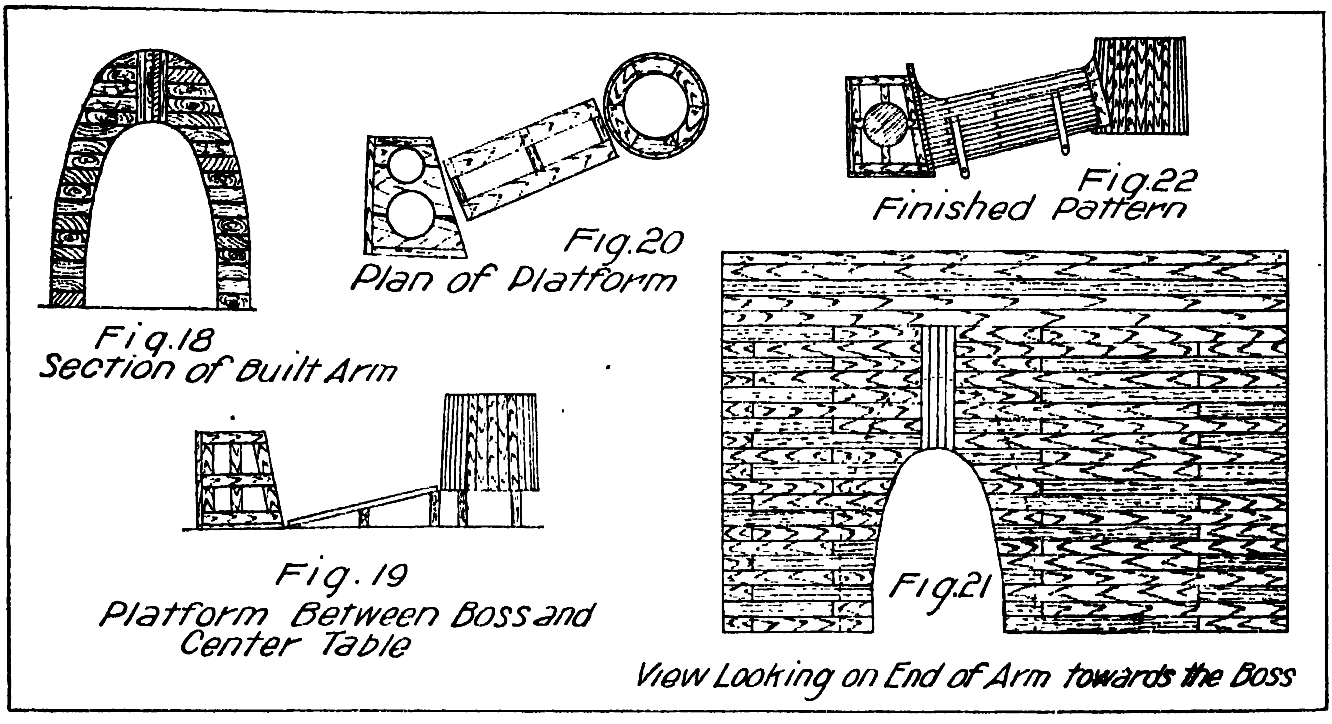


FIG. 18—SECTION OF BUILT UP ARM FIG. 19 PLATFORM BETWEEN BOSS AND CENTER TABLE FIG. 20—PLAN OF ERECTING PLATFORM FIG. 21—VIEW OF THE END OF THE ARM TOWARD THE BOSS FIG. 22—FINISHED DOUBLE ARM BRACKET PATTERN

them, but it is only necessary to screw every third or fourth segment to the barrels and the center table. It may be here mentioned that the length of the segment is a matter of judgment a sufficient lap being made for strength.

Fig. 21 is a view of the arm from the table end when it is built and finished. The top five courses are shown running from end to end. This binds the whole work and the number of such courses is determined by the point at which the radius *A*, Fig. 15, is tangent to a line drawn from one end frame to the other. When this point is reached in building, the top built rib must be sawed across and thus a level bed will be formed for the first long piece.

When the arms have been built, it will be necessary to do some finishing on the inside. There are sure to be when the ends at the outer edge have been shaped with the aid of a straightedge, a straight line may be drawn on the top edges. It then will be a simple operation to finish from this line to the bottom edge, after which they can be thicknessed.

Both inner and outer fillets at the barrels should be left loose, that is screwed so that they can be withdrawn separately. The patternmaker sometimes makes a few section pieces for these fillets and leaves the molder to fill between but for all the extra time that it takes up a full fillet in three or four segments is far more satisfactory.

In the finished pattern, Fig. 22, draw straps are shown, by which the molder may haul the arms from the mold. It is almost impossible to devise suitable battens or supports that will keep the as the feather edge will stand better if made of side-grained boards.

Slush to Prevent Rust

By H. E. Diller

Question—Please tell us what is used as a slush to prevent machined or bright, chilled surfaces on castings from rusting.

Answer—Vaseline is sometimes used. If a heavier slushing compound is desired, vaseline or mineral oil thickened to the desired degree with rosin can be used. Such a compound is not as easy to remove as is a coating of vaseline, and the more rosin there is in it the more difficulty will be experienced in removing the protective coating. Before applying the compound care should be taken to see that the casting is clean and free from rust.

DATA ON BELTS AND PULLEYS

By W. L. Tryon

Angle of Contact

Difference in diameters of pulleys (inches)	Distance between centers of pulleys in inches when angle of contact on smaller pulley is 120°	125°	130°	135°	140°	145°	150°	155°	160°	165°	170°	175°
1	..	....	....	....	....	....	....	....	....	....	....	11.5
2	..	....	....	....	....	....	....	....	....	....	11.5	23
3	..	....	....	....	....	....	....	....	....	11.5	17.2	34.5
4	..	....	....	....	....	....	....	....	11.5	15.3	22.9	46.
5	..	....	....	....	....	....	....	11.6	14.4	19.2	28.7	57.4
6	..	....	....	....	....	....	11.6	13.8	17.3	23.0	34.4	68.7
7	..	....	....	....	....	11.6	13.6	15.1	20.2	26.8	40.2	79.2
8	..	....	....	....	11.6	13.3	15.5	18.5	23.0	30.6	45.0	91.7
9	..	....	....	11.8	13.1	14.9	17.4	20.8	25.9	34.4	51.6	103.1
10	..	....	11.8	13.1	14.6	16.6	19.3	23.1	28.8	38.2	57.4	114.5
11	..	11.9	13.0	14.4	16.1	18.3	21.2	25.4	31.7	42.1	63.1	125.9
12	12	13.0	14.2	15.7	17.5	19.9	23.2	27.7	34.5	45.9	69.8	137.4
13	13	14.1	15.4	17.0	18.9	21.6	25.1	30.1	37.4	49.7	74.6	148.4
14	14	15.2	16.6	18.3	20.4	23.3	27.0	32.4	40.3	53.6	80.3	160.3
15	15	16.3	17.8	19.7	21.8	24.9	29.0	34.7	43.2	57.4	86.1	171.7
16	16	17.4	19.0	21.0	23.3	26.6	30.9	37.0	46.1	61.2	91.8	183.2
17	17	18.4	20.1	22.2	24.8	28.3	32.8	39.3	48.9	65.1	97.5	194.6
18	18	19.5	21.3	23.5	26.2	29.9	34.8	41.6	51.8	68.9	103.3	205.1
19	19	20.6	22.5	24.8	27.7	31.6	36.7	43.9	54.7	72.7	109.0	217.5
20	20	21.7	23.7	26.1	29.2	33.3	38.6	46.2	57.6	76.6	114.7	229.0
21	21	22.8	24.9	27.4	30.7	35.0	40.5	48.5	60.5	80.4	120.5	240.4
22	22	23.9	26.2	28.7	32.1	36.6	42.5	50.8	63.4	84.2	126.2	251.9
23	23	24.9	27.4	30.0	33.6	38.3	44.4	53.1	66.3	88.1	132.0	263.3
24	24	26.0	28.5	31.3	35.1	40.0	46.3	55.4	69.1	91.9	137.7	274.8
25	25	27.1	29.7	32.7	36.5	41.6	48.3	57.7	72.0	95.7	143.4	286.2
26	26	28.2	30.9	34.0	38.0	43.3	50.2	60.1	74.9	99.6	149.2	297.7
27	27	29.3	32.1	35.3	39.5	45.0	52.1	62.4	77.7	103.4	154.9	309.1
28	28	30.3	33.3	36.6	40.9	46.5	54.1	64.7	80.6	107.2	160.6	320.6
29	29	31.4	34.4	37.9	42.4	48.2	56.0	67.0	83.5	111.0	166.4	332.0
30	30	32.5	35.6	39.2	43.9	49.8	57.9	69.3	86.4	114.9	172.1	343.5
31	31	33.6	36.8	40.5	45.3	51.5	59.9	71.6	89.3	118.7	177.8	.....
32	32	34.6	38.0	41.8	46.8	53.2	61.8	73.9	92.2	122.5	183.6	.....
33	33	35.7	39.2	43.1	48.3	54.8	63.7	76.2	95.1	126.4	189.3	.....
34	34	36.8	40.3	44.4	49.7	56.5	65.7	78.5	97.9	130.2	195.1	.....
35	35	37.9	41.5	45.8	51.2	58.2	67.6	80.8	100.8	134.0	200.8	.....
36	36	39.0	42.7	47.1	52.7	59.8	69.5	83.2	103.7	137.8	206.5	.....
37	37	40.0	43.9	48.4	54.1	61.5	71.5	85.5	106.5	141.7	212.3	.....
38	38	41.1	45.1	49.7	55.6	63.2	73.4	87.8	109.4	145.5	218.0	.....
39	39	42.2	46.3	51.0	57.0	64.8	75.3	90.1	112.3	149.3	223.7	.....
40	40	43.3	47.3	52.3	58.5	66.5	77.3	92.4	115.2	153.2	229.4	.....

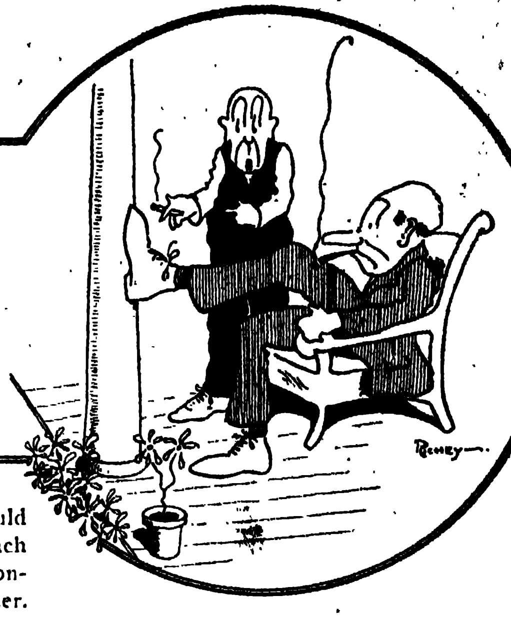
(Concluded on Data Sheet No. 308)

DATA ON BELTS AND PULLEYS

By W. L. Tryon

(Concluded from Data Sheet No. 307)

Difference in diameters of pulleys (inches)	Distance between centers of pulleys in inches when angle of contact on smaller pulley is 120°	125°	130°	135°	140°	145°	150°	155°	160°	165°	170°
41	41	44.3	48.5	53.6	60.0	68.2	79.2	94.7	118.1	157.0	235.2
42	42	45.4	49.7	54.9	61.4	69.6	81.1	97.0	121.0	160.9	241.0
43	43	46.5	50.9	56.2	62.9	71.5	83.1	99.3	123.9	164.8	246.7
44	44	47.6	52.0	57.5	64.3	73.2	85.0	101.6	126.8	168.6	252.4
45	45	48.7	53.2	58.8	65.8	74.8	86.9	104.0	129.7	172.5	258.2
46	46	49.8	54.4	60.1	67.3	76.5	88.9	106.3	132.6	176.3	263.9
47	47	50.9	55.6	61.4	68.7	78.2	90.8	108.6	135.4	180.1	269.6
48	48	52.0	56.8	62.7	70.2	79.8	92.7	110.9	138.3	183.9	275.4
49	49	53.1	58.0	64.0	71.6	81.5	94.7	113.2	141.2	187.7	281.1
50	50	54.2	59.2	65.3	73.1	83.2	96.6	115.5	144.1	191.5	286.9
51	51	55.2	60.3	66.7	74.6	84.8	98.5	117.8	147.0	195.4	292.6
52	52	56.3	61.5	68.0	76.0	86.5	100.5	120.2	149.9	199.2	298.3
53	53	57.4	62.7	69.3	77.5	88.2	102.4	122.5	152.8	203.0	304.1
54	54	58.5	63.9	70.6	78.9	89.8	104.3	124.8	155.7	206.9	309.8
55	55	59.6	65.1	71.9	80.4	91.5	106.3	127.1	158.5	210.7	315.5
56	56	60.7	66.3	73.2	81.9	93.2	108.2	129.4	161.4	214.5	321.3
57	57	61.7	67.4	74.5	83.3	94.8	110.1	131.7	164.2	218.4	327.0
58	58	62.8	68.6	75.8	84.8	96.5	112.1	134.0	167.1	222.2	332.7
59	59	63.9	69.8	77.1	86.2	98.2	114.0	136.3	170.0	226.0	338.5
60	60	65.0	71.0	78.4	87.7	99.8	115.9	138.6	172.8	229.8	344.2
61	61	66.1	72.2	79.7	89.2	101.5	117.9	140.9	175.7	233.7	.....
62	62	67.2	73.4	81.0	90.7	103.2	119.8	143.3	178.6	237.5	.....
63	63	68.2	74.5	82.3	92.1	104.8	121.7	145.6	181.4	241.3	.....
64	64	69.3	75.7	83.6	93.6	106.5	123.7	147.9	184.3	245.2	.....
65	65	70.4	76.9	84.9	95.1	108.2	125.6	150.2	187.2	249.0	.....
66	66	71.5	78.1	86.2	96.5	109.8	127.5	152.5	190.1	252.8	.....
67	67	72.6	79.3	87.5	98.0	111.4	129.5	154.8	192.9	256.6	.....
68	68	73.6	80.4	88.8	99.5	113.1	131.4	157.1	195.8	260.5	.....
69	69	74.7	81.6	90.1	100.9	114.7	133.3	159.4	198.7	264.3	.....
70	70	75.8	82.8	91.5	102.4	116.4	135.2	161.7	201.6	268.1	.....
71	71	76.9	84.0	92.8	103.9	118.0	137.1	164.0	204.5	271.9	.....
72	72	78.0	85.2	94.1	105.3	119.7	139.0	166.3	207.4	275.8	.....
74	74	80.1	87.5	96.7	108.2	123.0	142.9	170.9	213.1	283.4	.....
76	76	82.3	89.9	99.3	111.2	126.3	146.7	175.5	218.9	291.1	.....
78	78	84.4	92.2	101.9	114.1	129.7	150.6	180.2	224.6	298.7	.....
80	80	86.6	94.6	104.5	117.0	133.0	154.5	184.8	230.4	306.4	.....
82	82	88.8	97.0	107.1	119.9	136.3	158.4	189.4	236.2	314.1	.....
84	84	90.9	99.3	109.7	122.8	139.7	162.2	194.0	241.9	321.7	.....
86	86	93.1	101.7	112.3	125.8	143.0	166.1	198.6	247.7	329.3	.....
88	88	95.3	104.0	115.0	128.7	146.3	170.0	203.3	253.4	337.0	.....



Bill Has a Word on the Column Proposition

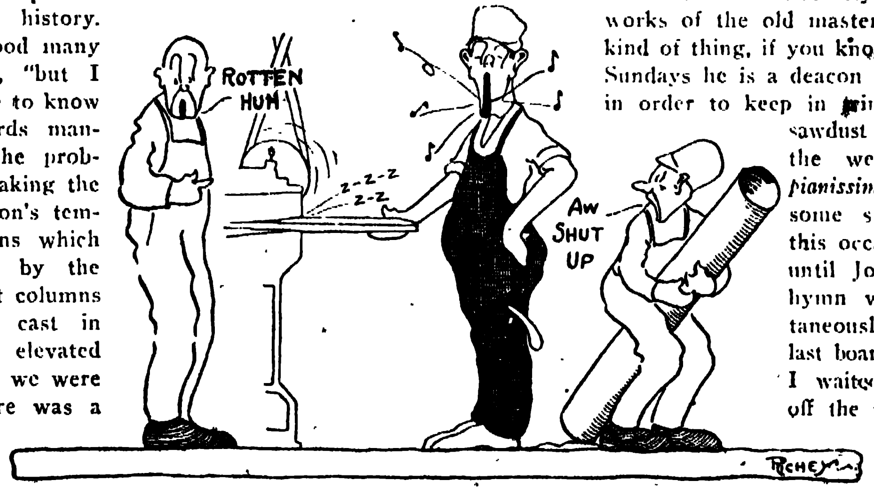
BY PAT DWYER

WHILE sitting on Bill's verandah one Sunday afternoon recently, I commented in an idle way on the extraordinary size of the columns supporting the porch roof. That little innocent remark started a discussion on columns which would be going yet if Bill's wife had not called him in to mind the baby while she fixed her hair.

I ventured the opinion that all columns under 16 feet long should be cast on end like water pipe Bill dodged the argument, preferring to allow his mind to wander back into ancient history. "I have made a good many columns," said he, "but I would certainly like to know how those old birds managed. Think of the problems involved in making the columns for Solomon's temple; or the columns which Sampson tore up by the roots or the 55-foot columns which Jim Floyd cast in New York for the elevated railroad back when we were kids." I said there was a lot of difference between making columns in a house work shop and a jobbing shop. "You said something that time," said Bill. "Whenever I hear of columns it reminds me of an experience I had in a place I worked one time. They used to make quite a number of columns in the run of a year. Several wooden flasks were in existence but between poor design in the first place and exposure to the weather in the second they were regular 'baskets.' It did not make so much difference in the short lengths, as by exercising particular care castings could be made in them. The long flasks however were hopeless. Rolling the cope over pulled the flask out of line and when the casting was made and lifted out in the morning the joint would be matched perfectly at each end but would show a considerable shift in the center. Of course it could be chipped, but it meant a lot of extra work and the casting always had a second hand lopsided appearance even after it was finished.

"The owner of the foundry was no better pleased than I but was firmly convinced that the shift was the result of carelessness on the part of the molder. I told him that if we had a solid-iron cope we could get straight, perfectly matched castings irrespective of the molder's carlessness. During one of these discussions he intimated that I might go ahead and make an iron cope the next slack spell we had.

"When I want a thing done I can generally find an opportunity of doing it. I went over to the pattern shop to try and interest my old friend John in the proposition. I found him running some boards through the pony planer and singing at the top of his voice. He loves to sing but lacks the courage to do it openly or without a disguise of some sort. The noise of the planer affords him protection, but even as thus handicapped I have seen the man on the next bench give him a hard look on occasions.



HE LACKED THE COURAGE TO SING OPENLY

"John is one of the 'life is real, life is earnest' class of human beings and therefore he does not carol gaily the frothy nothings which pass for songs in this day and generation. Not at all. Far from it. He employs his talent exclusively in interpreting the works of the old masters, cantatas and that kind of thing, if you know what I mean. On Sundays he is a deacon and choir leader and in order to keep in trim he coughs up the sawdust a few times during the week and runs over *pianissimo* a verse or two of some standard hymn. On this occasion I stuck around until John had finished the hymn which he did simultaneously with passing the last board through the planer. I waited until he had shut off the power and there was some chance of making myself heard. 'John,' I said, 'if you can spare me a minute of your valuable time I wish to say a few words of the utmost importance.' 'Nothing doing,' said he, 'I never lend anybody anything.' 'All I want you to lend me,' I said, 'is your ears. Heaven knows they are long enough and sharp enough and hairy enough to account for you being such a kicker. I don't want to keep them, I merely wish to enlist your sympathy and co-operation in producing certain results which I now have under consideration.' 'If you will kindly cut the queer stuff,' said he, 'and the personal allusions, and say briefly what you have to say, I'll see about it. Your conscience may allow

you to come over here wasting your time, but I have work to do.'

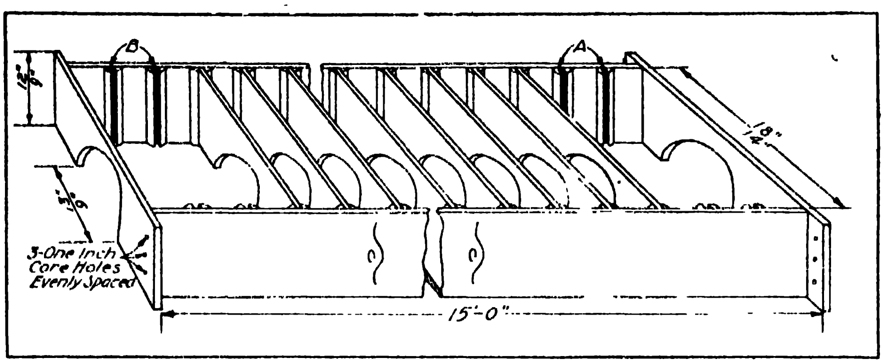
"'John,' I said, 'your words do you credit. They show that you have a strong conscience but a weak heart. You jump to conclusions too quickly. I am not wasting my time. 'Tis true I am not actively engaged in wrestling with the world, the flesh and the devil, but I am trying to give the man who employs me a fair return on his investment. I am thinking of changing our practice for making columns. The proposed change will save time, will eliminate drops and crushes, will assure straight castings and above all, the joint of the casting will not be disfigured by a half inch shift along the middle. Now in view of all these benefits, don't you think that your expressed opinion of me is a little harsh and unchristian-like, to say the least?'

"'I still fail to see where all this bunk interests me,' said he. 'Why John,' I said, 'I am surprised; your nimble mind is generally able to jump across all the preliminary steps, but if you insist on a full and detailed statement, here it is, viz., i. e. to wit, as follows:

"'I wish to make a couple of iron copes and since I cannot make them without a pattern of some kind I would now respectfully beg, plead, urge, cajole, coax, threaten, persuade or otherwise request that you provide, build, make, fabricate, manufacture, produce and deliver a suitable pattern or patterns for the aforesaid purpose.' 'Oh,' said he, 'boil it down; cut it short. Give me something definite. What do you want?' 'All right,' I said, 'cock your long ears and pay attention. I want two solid iron copes each 15 feet long. One with the bars cut out to accommodate columns 12 inches in diameter and the other cut out for columns 8 inches in diameter. With these two flasks we can make any size from 4 to 12 inches. They are to be open at the ends, that is the end pieces of the flasks will be the same as the bars. I want two vertical flanges at each end with three 1-inch cored holes in each. These are for the purpose of attaching extension pieces in case we have to make columns over 15 feet long. We will leave two bars out near each end but provide sockets in which we can wedge wooden bars in case we get a column with an elaborate base. We will put the handles on with cores, two on each side. Now there you are, is that clear and explicit enough?'

"'Oh, sure,' said he, 'with the exception that you did not say what the height or width was going to be, or what thickness you wanted the sides and bars and vertical flanges at the ends; or whether you need a complete pattern or can get along with a set of loose pieces. With these few exceptions the explanation is clear.'

"'Well, now John, I'll tell you,' I said, 'I could have worked out all those details but I thought it might afford you a certain amount of pleasure to work them out for yourself.'



BILL AND JOHN CONTRIVED AN EXTENSIBLE COPE

'Beat it,' said John, 'you not only expect me to make the pattern but you also want me to design it, the next thing I know you will want me to go over to the foundry and mold the job for you.' 'Don't be alarmed,' I said. 'It takes a real man with hair on his chest like a billy goat to make a mold. If you will let me have one of your numerous pencils for a minute I will make you a sketch and furnish full specifications.'

"I selected a nice fat red pencil from his pocket and picked up one of the boards which he had just planed to thickness with the laudable intention of making a sketch on it. He let out a howl like I had stepped on his toe and said: 'Here, drop that, there are lots of pieces of lumber lying around without taking a piece that I am just going to use.' I told him not to speak to me so rudely and roughly or I would go back to the foundry where none of that rough stuff was allowed in order to finish the job. 'Go ahead,' said he, 'you can't go too quick or too soon to suit me.'

"It was a bitterly cold day so I left the door open purposely when I went out. I knew from experience that nothing aggravated him so much as for someone to do that. When I was about half way back to the foundry I had the pleasure of hearing the door slam so I knew the measures were effective.

"I made a sketch and took it over to him the next day. He wanted to know what all the figures were for. I explained to him that the supply of stationery in my ebony and ivory escritoire was all gone when I went to look, with the exception of one sheet so I had to make the one sketch do for the two copes. The design was the same for both and I had marked both sets of dimensions.

"'Pretty rough work,' said he, 'but what could one expect from a molder?' I told him I did not know what one expected but I knew what one usually got if one aired his opinions too freely in the molder's presence and hearing. 'Personally,' I said, 'I am opposed to violence and the shedding of human blood but I sometimes make exceptions in favor of patternmakers and others who have no friends.'

"'If I can get a seconder,' said John, 'I move you that we suspend the regular order of procedure and go back to "unfinished business." Under that heading we can take up the consideration of your flask which I now see has several very meritorious features.

"I never refuse to grab the olive branch when it is held out to me. 'Don't say "your flask,"' I said, 'say "our flask" for I realize that your share of the job is the more important of the two.'

"Having sprinkled these few kind words, like the balm of Gilead, I left, carefully closing the door.

"John brought the pieces for the pattern over the next day and as I had expected they were better than the ones I had doped out in my own mind. Each side piece was 6 feet long and he had nailed a pair of heavy fillets at each place to locate the bars. They are shown at *A* and *B* in the sketch. The end pieces and vertical flanges were held in place with screws. Four loose bars were provided. We dug a hole, 17 x 1 x 3 feet, in the foundry floor and with the aid of a line and level bedded in bricks at convenient intervals to serve in locating the pattern each time it was shifted. The rest of the job was a matter of routine.

"We set the pattern on the first set of bricks, dropped the four loose bars into their places, leaving the two end spaces clear; set up two handle cores,

one on each side and rammed it up, inside and out. We had to shift the bars as we went along and to insure the sand between bars standing up after the patterns were removed a row of soldiers was rammed up in each space. We removed the screws from the end pieces, one at each ramming and when the mold was rammed to the top, we drew the pattern one piece at a time.

"The pattern was assembled again and dropped into place by letting the two free ends lap into the mold the width of one bar. The pattern was rammed for a distance of about 4 feet and drawn out again. The next time it was set to make the total length, the second pair of handle cores were placed and the rest of the mold rammed up and finished.

"Instead of pouring the job at both ends at the bottom we made up a long basin on one side and poured it from the top, letting the iron enter about a dozen bars at one time. We made the smaller cope in the same way the following day and afterward we made two extension pieces for each of them; and, believe me, after that we had no more shifted columns."

At this point, as I remarked before, Bill's wife asked him to hold the baby and I knew it was time for me to move. A woman can hold a baby and carry on a conversation at the same time but I never saw a man who could do it cheerfully and get away with it. Of course if it is a well trained baby, one of these eugenic babies you read of in the papers every once in a while, which eats and plays and sleeps on a stop watch schedule it might be done, but Bill's baby was not one of that kind.

Making Short Drums from Long Patterns

By Mollison Herbert

A standard drum 48 inches long was designed to be molded on end. It was provided with a 3-inch flange, top and bottom. The top flange was attached firmly to the pattern while the bottom flange was loose. An unexpected emergency made necessary the production of a drum similar in all respects to the standard, except that the length desired was 23 instead of 48 inches. This drum was made from the standard pattern in the following manner:

A hole was dug in the floor approximately three-fourths the depth of the pattern or in other words deep enough to allow 12 inches of the pattern to project above the floor level. The pattern was placed in the hole, trued up and leveled but no attempt was made to get any impression of the bottom hub. Sand was filled in around the pattern and the hole rammed up flush with the floor. A straight edge with a piece 12 inches long depending from one end of it was used to strike a level parting around the pattern. This parting was slicked, parting sand thrown on and a cheek 12 inches deep placed around the pattern. The cheek was rammed flush with the top of the pattern, a parting made and a cope set on. The cope was rammed and lifted off, then the pattern was drawn and the cheek lifted off.

The pattern was then taken and bedded properly in the floor in a new place. A parting was made flush with the top side of the loose flange. Now since there was a cheek 12 inches deep already rammed up and the required casting was to be 23 inches, it followed that another cheek 11 inches deep would be sufficient. Accordingly a cheek the required depth was set on and rammed up and a parting made using the top face of the cheek frame for a guide. The pattern was then drawn, the cheek taken off and the lose ring pattern removed. After the mold was finished and blacked it was assembled by putting the last cheek on first, then the other.

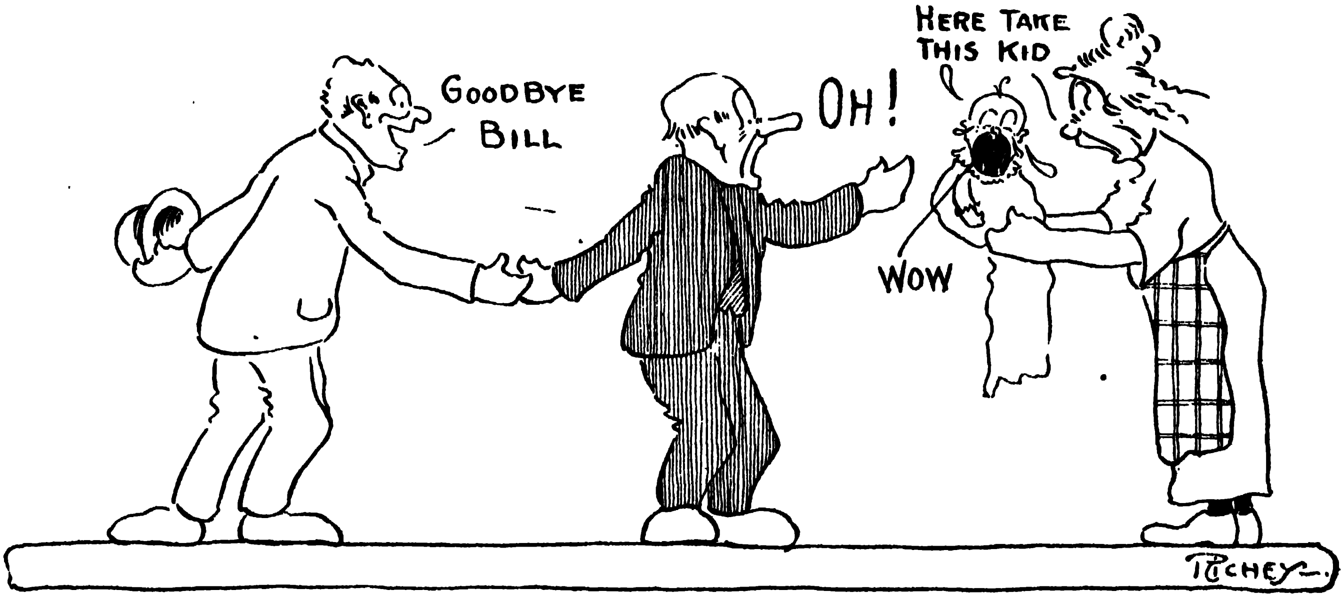
Long Prints Not Needed on Pipe Bends

By M. E. Duggan

Cutting four half core prints from 2-inch stock and fastening them to a pattern is a simple and easy job for the patternmaker; but gluing up stock, turning the four half prints, cutting the recesses, fitting and fastening the prints in the pattern, means labor, time and material and adds to the cost of the pattern especially for a single casting.

There is a difference of opinion among molders and patternmakers regarding the proper length of core prints on pipe bend patterns. Some are in favor of long prints while others are in favor of short prints. I have never met a man, patternmaker or molder who could convince me that short prints were contrary to good molding practice because I have seen good castings made every day from such patterns.

The question resolves itself into two phases which may be briefly summarized. The short prints give satisfactory results provided they rest in rigid bearings and chaplets are provided top and bottom in the center of the bend to hold the core in position before and during the casting operation. This applies to both large and small pipes. The only advantage of using long prints is that small bends need no chaplets.



NO MAN CAN CARRY BOTH A BABY AND A CONVERSATION AT ONE TIME

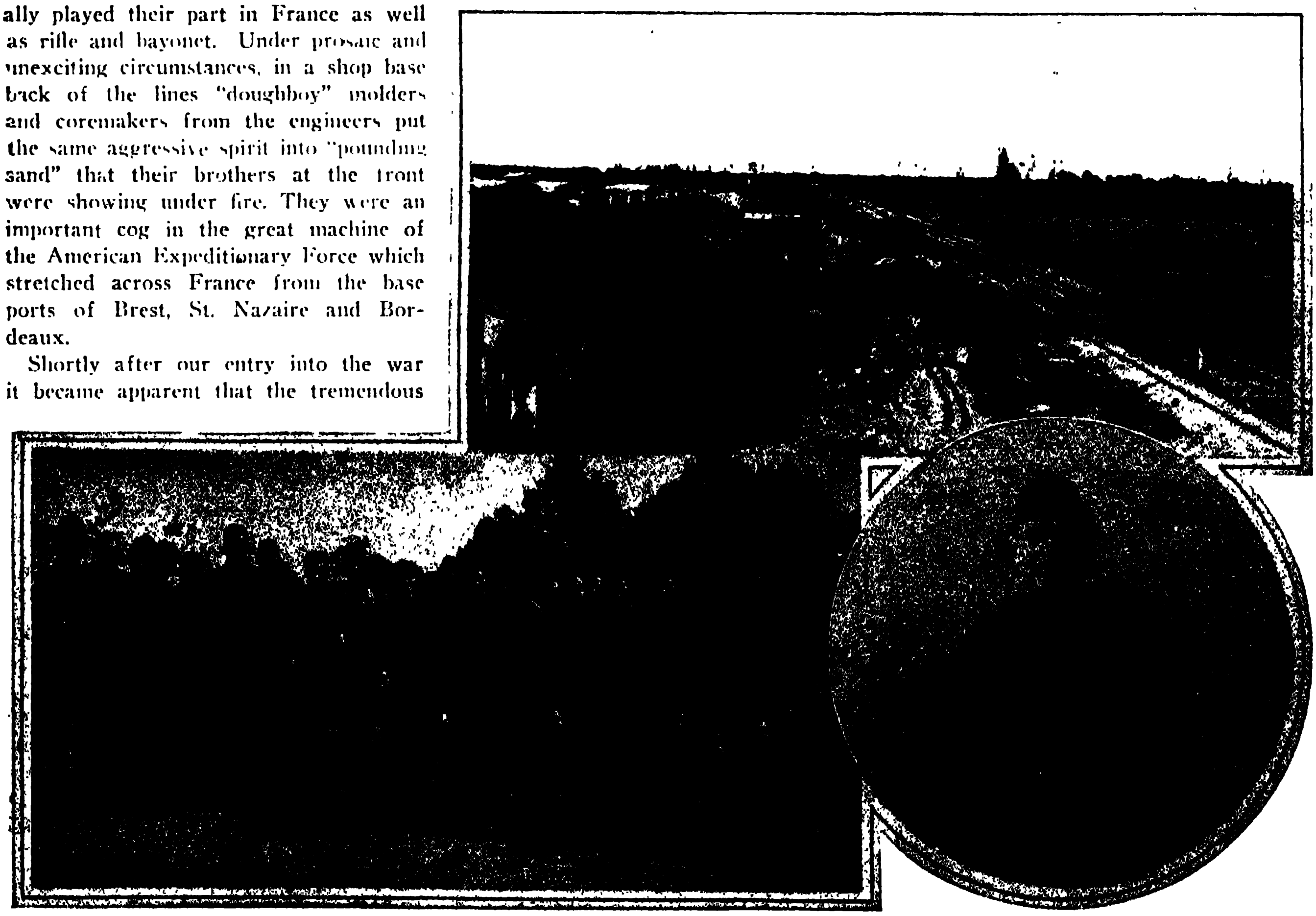
How the Foundry Served Overseas

Immediate and Pressing Need of Repairs for Guns, Mounts, Tractors, Locomotives, Tanks and Machines of All Kinds Demand the Establishment of Foundry Facilities in France

Practically every military branch which composed the A. E. F. has reported its particular task and recounted how each duty was well performed. On the eve of the first anniversary of the armistice, it is permitted to detail the work of that unit which formed the outpost of the American foundry industry overseas, a unique link between the army in the field and the industrial forces at home.

EVERYONE knows that the foundry industry at home "did its bit" toward victory in a direct way by its work on guns and munitions, and in a less direct but equally important way by aiding the manufacture of a tremendous amount of mechanical equipment that was necessary to transport, feed, equip and support the army across the sea. Few, however, know that besides fulfilling important tasks at home, the foundry actually threw its outposts overseas and that shovel and rammer actually played their part in France as well as rifle and bayonet. Under prosaic and unexciting circumstances, in a shop base back of the lines "doughboy" molders and coremakers from the engineers put the same aggressive spirit into "pounding sand" that their brothers at the front were showing under fire. They were an important cog in the great machine of the American Expeditionary Force which stretched across France from the base ports of Brest, St. Nazaire and Bordeaux.

Shortly after our entry into the war it became apparent that the tremendous amount of mechanical equipment sent abroad would require extensive repair facilities and that the French industrial organization, with its depleted personnel, could lend no aid. The engineer corps, therefore, made up a comprehensive plan of repair shops with a proposed base shop at Gievres (*Loir et Cher*) which was a center of activities in the service of supplies as the principal and largest supply depot. This base was to be known as General Intermediate Depot No. 1. As planned it was to consist of six buildings, each 50 x 500 feet. The operating force was set at 750 men. One of the six buildings planned was to be a foundry while a pattern shop was to occupy part of another. Further, there was to be an advance shop at Is-sur-Tille (*Cote d'Or*) where an advance supply depot of approximately the same capacity was to be located, this also was to include a foundry. It was planned to establish with each army in the field one semipermanent metal and wood shop for mechanical work only and five small advance shops. The original specifications for the small advance shops stated that they were to be placed as closely as possible to the front line trenches and that "Shell fire is to be a secondary consideration." However, portable shops on motor trucks were substituted later for the small advance shops.



ABOVE: GENERAL VIEW OF THE FOUNDRY, CUPOLA HOUSE, MATERIAL YARDS AND TRACKS AT THE GIEVRES BASE SHOP—MOLDERS AND COREMAKERS FOR THE GIEVRES FOUNDRY WERE RECRUITED FROM THE 34TH ENGINEERS—INSET, SERGEANT J. F. GEARY, FOUNDRY SUPERINTENDENT

Practically all of this general plan was executed before the armistice, but for obvious reasons the mechanical parts of the different shops were given first

attention. The first engineer machine shops at Is-sur-Tille commenced operations on a small scale about the end of March, 1918, and fairly complete wood and metal repair shop at the Gievres base plant commenced operations June 27, but it was not until July 24 that the foundry building at Gievres, was completed by the civilian contractor and turned over to the engineers.

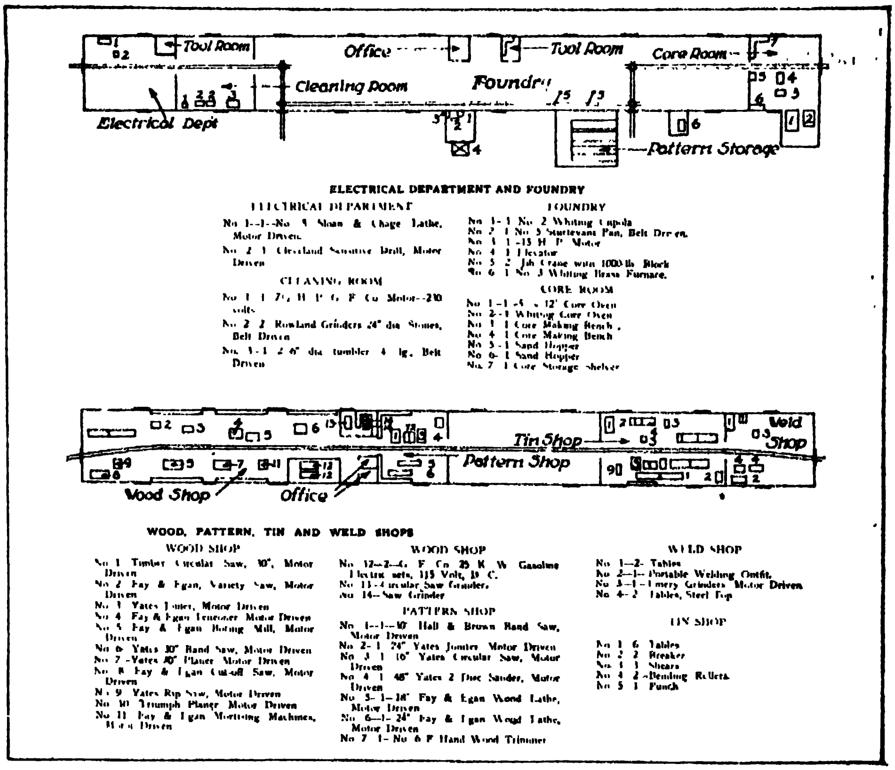
The foundry building, 50 x 500 feet, was one of the standard type light steel frame covered with corrugated iron used in large numbers in France for warehouses. It followed standard construction in the small ventilators and windows placed high under the eaves and this made it necessary to remodel the building to adapt it to foundry needs. A liberal number of pipe ventilators was put in the roof and swinging window frames covered with oiled cloth (glass was nearly as extinct as the dodo "over there") in the side walls.

On account of the narrowness of the building (50 feet) it was not considered advisable to have cupola, core room, pattern vault or brass furnace inside the building. Accordingly structures were added along one side to house these as shown in the accompanying plan.

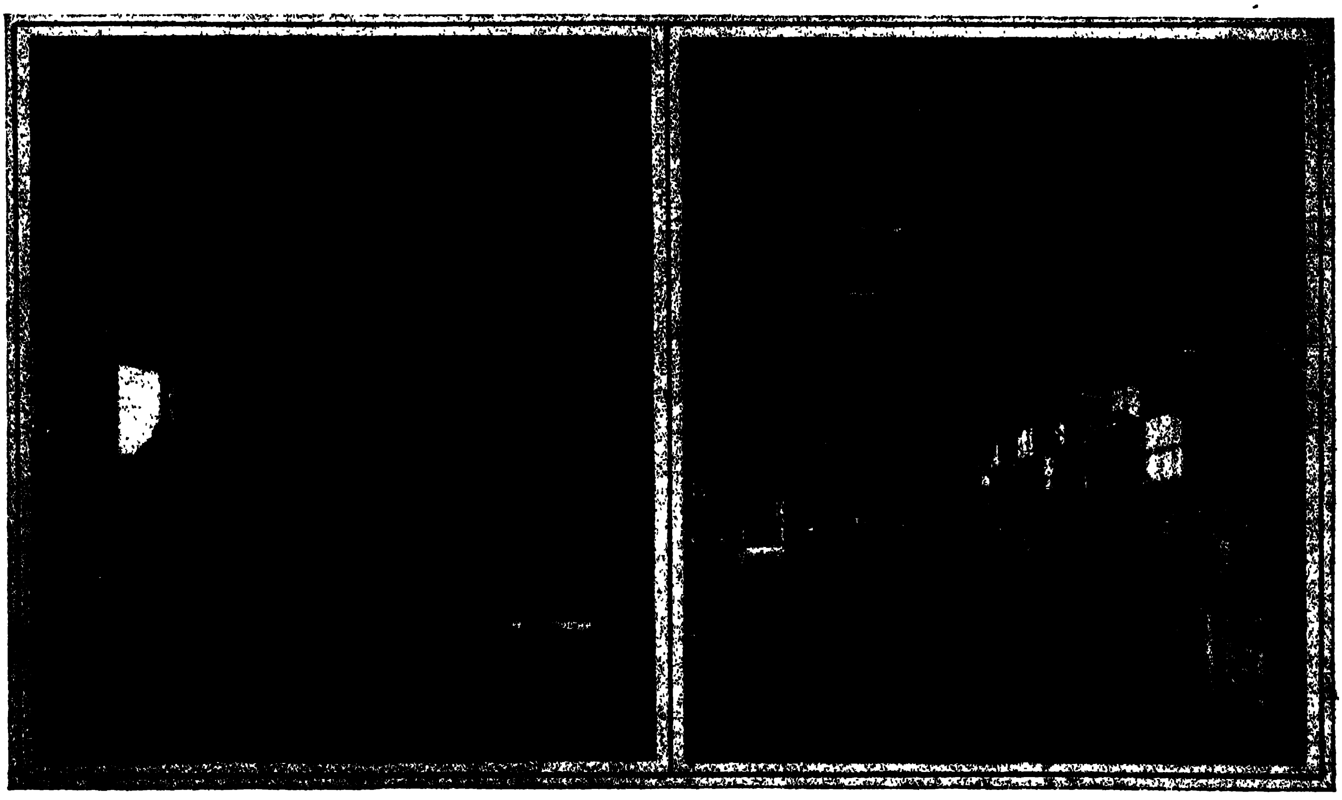
The floor was rough and the furrows left by a potato patch which was flourishing when erection started made it necessary to grade over the entire floor area. A pocket of tough clay was discovered just outside the foundry building and a top surface of this wet clay tamped smooth and hard gave a floor almost as good as concrete.

A narrow gage track was laid directly in front of the cupola along the full length of the foundry. This made it possible to handle iron to any floor in large geared truck ladles of 2000 pounds capacity. This same track connected with a complete system covering the foundry material yard, extending to the charging platform and through and around all of the other shops in the group.

A cupola built by the Whiting Found-



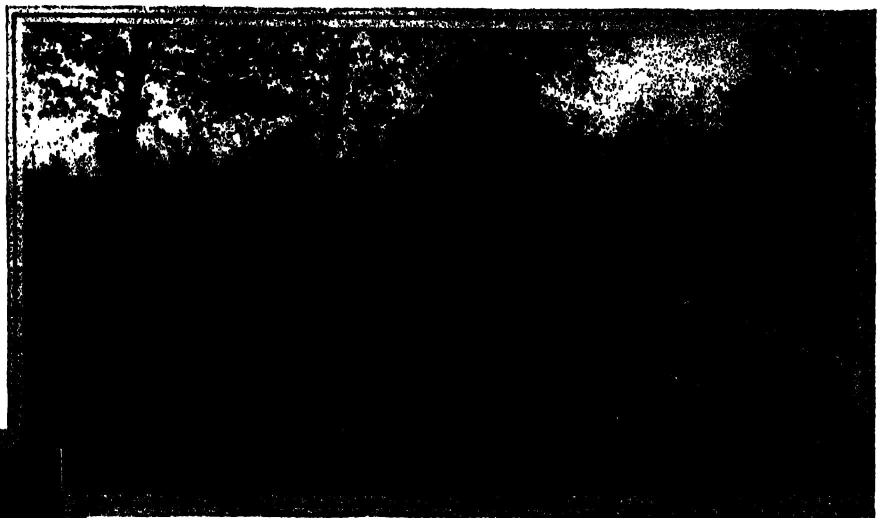
DETAILS OF FOUNDRY AND PATTERN SHOPS AT GIEVRES



THE CUPOLA WAS SET IN A SEPARATE BUILDING JUST OUTSIDE THE MAIN FOUNDRY FLOOR AND TRUCK LADLES RECEIVED THE METAL TAPPED—GENERAL VIEW OF THE WEST END OF THE FOUNDRY FLOOR

ry Equipment Co., Harvey, Ill., with a rated capacity of two tons per hour was installed. This was blown with a fan made by the B. F. Sturtevant Co., Boston.

Iron, coke and limestone were loaded upon cars in the foundry yard and lifted to charging platform on a power elevator. The charging platform had a floor of ¼-inch steel plates and the narrow gage storage tracks and turntables were so arranged that iron could be charged directly into cupola from cars, preventing rehandling from yard to cupola.



MOLDING SAND WAS UNLOADED FROM BARGES BROUGHT ON THE CANAL—SERGEANT ADAMS, ASSISTANT FOUNDRY SUPERINTENDENT IN THE FOREGROUND

WALL CRANES WERE CONVERTED TO PILLAR CRANES TO COMMAND THE TRACKWAY AND POURING FLOORS

The core oven equipment was a rolling shelf oven with five shelves or drawers. Only the shelves and their supporting frames were furnished from the States and of course it was necessary to design and build a brick fire box and setting. A 5 x 12-foot truck oven was completed just before the armistice to handle any larger core work which might be required later.

The cleaning room was equipped with two heavy English-made double wheel grinders carrying 3 x 24-inch grinding wheels, and a tumbling barrel, 2½ feet in diameter by 4 feet long.

One Whiting nonferrous furnace, coke fired, was installed in a separate building alongside the foundry to melt the brass and aluminum required.

For handling heavy work in the foundry, there were two cranes of 8-foot radius remodeled in the shops from wall type to pillar type in order to allow them to cover a full circle. These were rated at about 1½ tons and were set to swing over the narrow gage track so that the large ladles could be lifted out of their trucks and poured from the crane. All flasks and bottom boards including snap flasks for bench work and specially designed coremakers' tables, molders' benches and brass molders' tubs were built in the shops. A few steel flasks ordered from American manufacturers were in use.

As previously stated, the building was turned over on July 24, 1918. On Sept. 17 the first brass heat was poured and Sept. 20, a little less than two months after taking over the building, the first heat of gray iron was poured. The foundry was at that time completely equipped as described and shown in the illustrations which were taken from photographs taken during operations,

It was at this time the only gray-iron foundry completed and in operation by the army overseas. A fully equipped pattern shop was in operation. The foundry was ready to meet all requirements for gray iron, brass and aluminum castings and orders were on hand for a considerable amount of work for the army.

The shop personnel consisted of skilled molders and coremakers from the thirty-fourth engineers, a regiment specially organized to operate the engineer shops and depots. The foundry and all shop activities at Gievres were under the general charge of Lieut. Col. Smitten of this regiment. Sergeants

A COMPLETE MACHINE SHOP WHICH FORMED A PART OF THE BASE SHOP SUPPLEMENTED THE WORK OF THE FOUNDRY DEPARTMENT AT GENERAL INTERMEDIATE SUPPLY DEPOT NO. 1

J. F. Geary and Samuel C. Hardman, detached from the eleventh engineers after six months service on the British front before Cambria, planned and executed the design of the foundry and its equipment. Sergeant Geary had charge of foundry operations until its closing after the armistice with Sergeant Adams of the thirty-fourth engineers as assistant.

In the short time it was in operation, the foundry turned out about 6 or 7 tons of brass castings and 70 to 75 tons of gray iron castings, covering a wide range of work, such as pulleys and hangers, parts for antiaircraft searchlight mounts and repair parts for locomotives, motor trucks, tanks, tractors and machinery of all sorts.

Cast-Iron Shoe Last Made in a Two-Part Flask

Question—We are forwarding sample of a shoe last which we have up to now been making in our foundry by hand. We wish to increase our output to 300 tons or about 80,000 lasts per year.

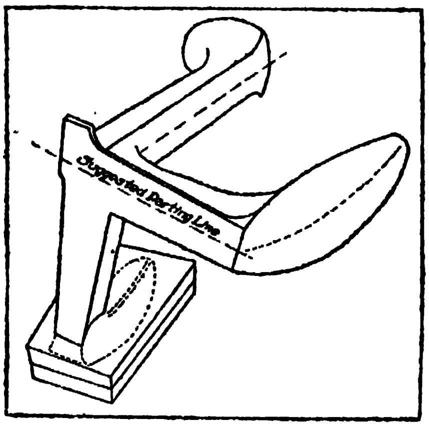
What do you consider the simplest and most effective method for producing this last on a molding machine, taking into consideration the following factors: (1) Scarcity of labor, which makes it necessary to employ machinery which will give the largest output per man; (2) What is the best type of box to use and how many castings should be made in each box (we have in mind either two or four); (3) Which is the better to use, a three or a four part box? That is to say a cope and drag and one or two middle parts.

Answer—Taking into consideration the points raised in your letter we would recommend that the pattern be split along the line shown in the accompanying illustration which would leave half of the large foot and heel in the cope. The small foot could be omitted from the pattern and made in a core. In this way the job could be made in an ordinary two part flask, or box, to use your term. We would not attempt to make more than one casting in each flask. A flask 8 x 10 inches with a drag 7 inches deep and a cope 4 inches will be large enough for the job and one man can handle it quite easily. If one man cannot meet the tonnage required, two men can be put to work, one on the copes and the other on the drags.

The advantages of this method are that the job is so simplified ordinary labor may be placed on it if necessary. The drag half of the pattern is mounted on a plain flat plate and the cope half on another which of course eliminates the necessity of making a parting on each mold. The two half cores for making the bottom foot are of the most primitive type and could be produced in quantity at a trifling expense.

We think that two plain hand squeeze, stripping-plate machines would meet your requirements.

In practice we would recommend that the drag frame be made in two sections, 4 and 3 inches respectively, the deep part to be placed around the pattern first, filled with sand, squeezed and struck off. The core to form the foot is then slipped over the stump of the pattern which has been left on for that purpose. The flat bed which has just been struck serves to locate it in the right position. The other half of



PERSPECTIVE VIEW OF LAST SHOWING PARTING LINE AND ALSO METHOD OF FORMING LOWER FOOT IN CORE

the drag is then placed, filled with sand, squeezed, struck off, the pattern dropped through the stripping plate, and the mold lifted off, turned over and set on the floor. The cope, of course, is simple.

Tapered Drag Core Prints

Question:—For a number of years it has been our policy to use a tapered print in the drag as well as the cope for all gated metal patterns. Occasionally we receive patterns from various sources which have straight prints in the drag. We would like to know why some patternshops continue to make these straight prints. We believe the tapered print is the most efficient and would like to know why the straight print is preferred in some cases.

Answer:—Many things are done in pattern shops for which it would be difficult to find a reason. Some of them are simply the result of custom, while others are done with the object of getting by with the least effort. Any faults or shortcomings in the finished pattern are due to laxity on the part of the foundryman and not the patternmaker. In a great many cases the foundryman contents himself with outlining in a general manner the way he wishes a pattern made. He leaves the details to the patternmaker, who of course makes it the easiest way. There is no more work involved in making tapered prints than there is in making straight ones, but there is more work in putting a tapered end on a corebox and for that reason the prints are made straight.

On the other hand there are many things done in a pattern shop for which there are very good reasons. In the cases where cores made on core machines are used, a straight core print is most suitable because it saves the molder the time required to file a tapered end on each core. If the bottom core print is of a reasonable length and the core fits snugly, the cope core print may be dispensed with, or, if a cope print is used, the drag print may be made so short that it does not increase the difficulty of drawing the pattern.

Taking the question broadly we would say that where the job warrants the making of special coreboxes, tapered core prints are justified inasmuch as they are bound to draw without disturbing the mold. Where cores are made on a stock core machine the straight core print is the best; of course by a straight print is meant one with sufficient draft to draw properly.

Recovering Copper From Scrap and Sweepings

A method of treating copper waste for recovery of the copper recently patented in Great Britain consists in roasting the copper sweepings and scrap with not less than 15 per cent of common salt, and 25 per cent of sand. The roasting is carried out in a two-part furnace which is a reverberatory furnace with a muffle underneath which arrangement enables varying temperatures to be obtained, as the temperature determines whether cuprous or cupric chloride shall be formed. The former chloride is volatile and is recovered by condensation, while cupric chloride is recovered by leaching with water and sulphuric acid. From these salts the copper is easily obtained free from the impurities which contaminated the scrap.

The Shawinigan Electro Metals Co., Ltd., has moved its United States sales offices from the Leader-News building, Cleveland, to 1500 Westminster building, Chicago, where D. C. Falconer is located as sales agent. The company also has arranged to carry stocks of magnesium in warehouses in New York, Chicago and Detroit.

THE FOUNDRY

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Contents

Centralized Metallurgical Control

KNOWLEDGE is gained through experience, study and research. Every one who works in a foundry has more or less opportunity to acquire a limited amount of metallurgical experience and there are a number of books on metallurgical subjects through the study of which, some knowledge of the properties of foundry metals may be gained. Research, then is the only pathway to metallurgical knowledge which is closed to most foundrymen.

Many foundries do not employ a metallurgist. The superintendent is supposed to have sufficient practical knowledge of iron and its control to handle any problems which arise. Usually he gets along in a passable, though not entirely satisfactory manner, and occasionally he is confronted by a problem he can not solve. Sometimes on such occasions he obtains a book on metallurgy and tries to ascertain the remedy for his trouble. This, however, is difficult even with a limited knowledge of metallurgy, for while books cover the field broadly and in a general way, it requires a trained mind to follow and definitely lay hold of the cause and remedy for an individual case.

The foundry which employs a metallurgist is somewhat more fortunate. Its metallurgical problems are solved more readily; but let us consider what ability the average foundry metallurgist has for controlling the mixing, melting and pouring of iron. Usually he is a chemist and can analyze the metal and so control the mixture. Also, he usually has had a limited amount of experience in the lines manufactured by the particular foundry by which he is employed. In most foundries, however, only one metallurgist is employed, especially in the many small shops, and thus the solitary worker loses the advantages of an interchange of ideas so helpful to a broad, technical development. This lack is partially compensated through visits to other foundries and the meetings and proceedings of technical societies, but neither of these advantages fills the place of a broad, actual experience in contact with other workers in the same line. Some large foundries are able to employ several metallurgists and to give them ample facilities for research in the laboratories and shops, but even such foundries frequently lack the diversity of work which is so helpful in furnishing thorough experience to the metallurgist. Therefore, there is a long step ahead which has not yet been taken by the technical branch of the foundry industry. If all the foundries in different districts would combine to establish central laboratories from which the iron of the supporting foundries could be controlled, the advantages would be great. While such a laboratory need not be primarily of the research type, yet it should have enough equipment for solving every metallurgical problem with which the local foundries are confronted. A first class metallurgist could be placed in charge and with others under his direction, an interchange of ideas and an accumulation of broad experience could be obtained.

Trade Outlook in the Foundry Industry

ALTHOUGH not entirely unscathed, the foundry industry has not been seriously hampered by the multitude of industrial calamities which have assailed it indirectly to date. The steel strike found most plants well stocked with iron and although some special grades were off the market due to certain furnaces being down, the greater percentage of foundries are well stocked and continue to operate near full capacity. The threatened coal strike with its attendant spectre of a coke famine in most cases finds foundries prepared. Even though the strike occurs, most casting plants are stocked for at least two months' operation and the possibility of a mine strike of that duration is unthinkable.

Exceptions Exist

As in every instance, certain exceptions exist and these are found in the localities which are adjacent to the coke supplies which have been restricted by the steel strike. In the region surrounding Chicago and Milwaukee, in particular, the coke shortage was seriously felt even before the mine strike threatened still further curtailment. Many foundries in this district carry a very small stock of coke, depending upon nearby by-product ovens for prompt delivery. The steel strike, in a measure, crippled the ovens upon which these foundries depended and for the past few weeks coke has been sought from more remote sources. Coke dealers appreciating the situation have rushed quantities of both foundry and furnace grades into the region on consignment and the greater number of foundries, although somewhat embarrassed have been enabled to continue operations. Prompt coke prices reflecting the unprecedented conditions have commenced a series of fluctuations leading upward, and the finally established level is entirely problematical. Coke output is decreasing.

Prices of Raw Materials for Foundry Use

CORRECTED TO OCT. 27

Iron	
No. 2 Foundry, Valley	$28 00 to 28 75
No. 2 Southern, Birmingham	28 00
No 2 Foundry, Chicago	28.75
No. 2 Foundry, Philadelphia	32.10 to 33 10
Basic, Valley	25.75
Malleable Chicago	29 25
Malleable, Buffalo	27.25 to 29.00
Coke	
Connellsville foundry coke	6.00 to 6.50
Wise county foundry coke	8.00 to 8 50

Scrap	
Heavy melting steel, Valley	$19.50 to 20.00
Heavy melting steel, Pittsburgh	20.00 to 20.50
Heavy melting steel, Chicago	19.00 to 19.50
Stove plate, Chicago	25.00 to 25.50
No. 1 cast, Chicago	28.75 to 29 25
No. 1 cast, Philadelphia	25 50 to 26.00
No. 1 cast, Birmingham	21 00 to 25 00
Car wheels, iron, Pittsburgh	22.00 to 23.00
Car wheels, iron, Chicago	24 50 to 25 00
Railroad malleable, Chicago	22 00 to 22.50
Agricultural malleable, Chicago	22 00 to 22 50

Prices Mount

A steady price advance is noted in all localities in foundry pig iron for prompt shipment and although only a small tonnage has been sold for the first half of 1920 a higher tendency is evident. In the Middle West keen competition exists between buyers to secure the small available tonnage for delivery this year. This competition taken with advancing production costs has brought $30 pig iron and $32 iron seems imminent. Southern furnaces in the main are sold out for the remainder of the year and except for an occasional carload lot no iron is available for prompt delivery. The small amount of advance selling for 1920 is abnormal for this period of the year. Unsettled conditions have acted to deter both buyer and seller. Furnace interests seem of the opinion that production costs will undoubtedly rise, and the few first quarter sales which have been made are from 75 cents to $2 a ton over prevailing prices at this time. Scrap has been strongly affected by strike conditions. The inquiry in some localities for cupola scrap to substitute for pig iron has forced prices up, and dealers in many quarters are stocking their yards full in expectation of higher prices yet to follow.

Business Unexcelled

The unprecedented growth and expansion in foundry business in practically all lines continues, and is evident in all sections of the country. When the wave of increased business started in the automotive industries some apprehension was expressed that the foundation of prosperity was not sufficiently stable to support the the growth. That this feeling was unwarranted has been shown by the soundness which has marked the castings market during the threatened steel strike and subsequent unrest. When it is realized that the United States produces about 80 per cent of the world's output of automobiles and perhaps a larger percentage of the various types of industrial tractors, and that the production methods in use in this country fit domestic manufacturers to meet the competition of any foreign nation, the stability of the industry will be appreciated. That increase in business which had its inception in the automobile field has spread to practically all lines of castings manufacture, until at present foundries, are in most cases unable to assume any additional business before the first of the year. Manufacturers of stoves in the Middle West, unable to secure supplementary castings to make possible additional output in their own works, are seeking to place orders both in eastern and western foundry centers. Other castings for various construction and domestic uses are almost impossible to obtain. Manufacturers of plumbers' supplies state that there is a shortage of over a half million bath tubs; fittings of both iron and brass are practically unobtainable; and cast pipe makers are booked through until the first of the year, although municipalities have not purchased as liberally this season as in the past. Even foundries which specialize in piano plate, and castings which under war rulings were deemed nonessentials are enjoying unprecedented demand. Malleable shops are booked beyond their capacity, considering the available labor supply. Railroad repair work, foreign car orders and the possibility of extensive buying of railway equipment when the roads revert to private management offer much encouragement to malleable producers. Nonferrous prices are strong. Prices based on New York follow: Copper, 20.25c to 20.50c; tin, 53.50c; antimony, 8.75c to 8.87½c; aluminum, No. 12 alloy, producers' price, 31.50c, and open market, 30.50c. Zinc is 7.75c, St. Louis.

Comings and Goings of Foundrymen

William Jordan has resigned as assistant foundry manager for the American Seeding Machine Co., Springfield, O., to become associated with E. A. Parker and Frank Hook in the formation of the Springfield Aluminum Plate & Casting Co, which will build a plant for the manufacture of aluminum vibrator plates and castings. Mr. Parker was formerly in the pattern and experimental department and Mr. Hook was head of the vibrator production department of the American Seeding Machine Co.

J. H. Deppleler, Metal & Thermit Corp., New York, has been elected vice president of the American Welding society, and P. F. Willis, president, Henderson-Willis Welding & Cutting Co., has been made a director of the society.

Pierce F. Hayden has accepted the position of foundry foreman with A. T. Nye & Son Co., Columbus, O.

H. H. Outwater, of Rogers, Brown & Co, has been transferred from Buffalo to the New York office of the company, where he will be connected with the selling staff.

Charles H. Schmalz, formerly with the Hanna Engineering Works, Chicago, has been made assistant factory manager for the Holt Mfg. Co, Peoria, Ill.

C. W. Cross has been appointed manager of western railroad sales of the Chicago Pneumatic Tool Co. Mr. Cross will have his headquarters in the Fisher building, Chicago.

Fred S Campbell has resigned as foundry superintendent for the Hitchings Co, Elizabeth, N. J., to take charge of the foundry operated by the Turner Machine Co., Danbury, Conn.

William H. Savage, builder of machine tools, and Everett E. Wilbar, assistant treasurer of the Union Foundry Co., both of Fitchburg, Mass., are among the incorporators of the People's Trust Co., of that city.

George J. Webster has resigned as general manager of the Charcoal Iron Co. of America. He has been elected to the board of directors of the same company.

Wilmer M. Wood, traffic manager of the United States Cast Iron Pipe & Foundry Co., has resigned this position to become general freight agent of the Kerr Steamship Co., New York City. Mr. Wood had been associated with the United States company for the past seven years.

Walter P. Coghlan has resigned as secretary and sales manager of the Klaxon Co., Newark, N. J., to become general sales manager of the American Hammered Piston Ring Co., Baltimore.

Lieut. Col. R. L. Streeter has resigned as general manager of the government's arsenal at Rock Island, Ill., to become assistant mechanical engineer of the Aluminum Co. of America, New York.

Harold B. Dinneen has accepted the position as assistant to R. W. Lea, production manager of the Moline Plow Co., Moline, Ill. Mr. Dinneen was formerly manager of the John Deere Plow Co.

Frederick K. Acker, who has been assistant purchasing agent of Mackintosh, Hemphill & Co., Pittsburgh, has been promoted to the position of purchasing agent succeeding Charles W. Forcier who recently resigned.

John F. Schurch, operating vice president of the T. H. Symington Co., Rochester, N. Y., will take charge of all western sales of the company. He still retains the title of vice president. His headquarters will be in Chicago

Otto Rabe, president of the Kelsey Foundry Co., Chicago, has become affiliated with Christian M. Gottschau and others in the incorporation of the Gottschau Steam Motors Co., 1770 Berteau avenue, Chicago.

J. R. King has accepted a position as production manager and foundry superintendent for the Fate-Root-Heath Mfg. Co., Plymouth, O. Until recently he was with the Monroe Foundry & Furnace Co., Monroe, Mich.

W. K Frank, vice president of the Damascus Bronze Co., Pittsburgh, presented a paper at the bimonthly meeting of the mechanical section of the Engineers Society of Western Pennsylvania held at the Union Arcade auditorium, Pittsburgh, Oct. 14. The subject of the paper was "Notes on Bronze and Babbitt Bearings."

H. Z. Kelley will establish offices in the Stambaugh building, Youngstown, O., as northeastern Ohio representative of the Keystone Bronze Co. Mr. Kelley was formerly secretary and assistant manager of the Falcon Bronze Co., Youngstown, O., having been associated six years with this company.

James Feasy, foundry superintendent, Ruston & Hornsby, Ltd., Lincoln, Eng., who came to this country to attend the foundry convention at Philadelphia, remained to visit a number of the larger foundry centers of the east and middle west, returning to England the latter part of October. He visited representative foundries in Pittsburgh, Chicago, Milwaukee, Beloit and Kenosha, Wis., Cleveland, Detroit, Toronto, Buffalo and New York.

Charles W. Forcier, who for the past three years has been purchasing agent of Mackintosh, Hemphill & Co., Pittsburgh, recently resigned and has opened offices in the Union Arcade building as a sales engineer, in which capacity he will represent in western Pennsylvania, West Virginia and eastern Ohio, the Crucible Steel Forge Co., Cleveland, and the Exeter Machine Works, Inc., with a plant at Pittston, Pa., and executive offices at 30 Church street, New York. Mr. Forcier has been treasurer of the purchasing agents association of Pittsburgh for the past two years and will retain this position until the annual meeting of the association.

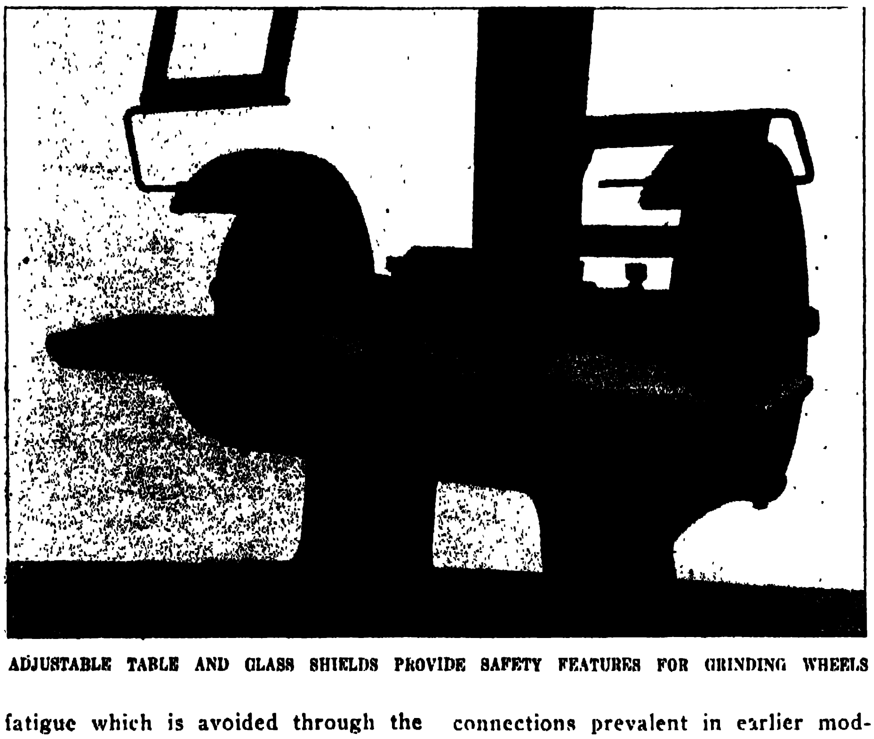
Addresses Pittsburgh Foundrymen

H. D. Gates, of the Pangborn Corp., Hagerstown, Md., was the speaker at the regular monthly meeting of the Pittsburgh Foundrymen's association which was held Oct. 14 at the Chatham hotel. Mr. Gates' talk, which was illustrated by lantern slides, was "Application of the Sand Blast in General Foundry Work." Carleton S. Koch, president of the Fort Pitt Steel Casting Co., McKeesport, Pa., recently elected president of the American Foundrymen's association, occupied a seat at the head table and was called on for a speech. He gave a brief talk relative to the affairs of the American Foundrymen's association, its problems and aims. He bespoke a more cordial interest in the annual convention and exhibit of the association on the part of the foundrymen and intimated that there was some possibility of the next convention being held in Pittsburgh provided an exhibition hall of sufficient size that

was fairly convenient to hotels could be secured. Finding such an arrangement, Mr. Koch asserted, was getting to be a good deal of a problem in practically all of the larger cities of the eastern half of the country.

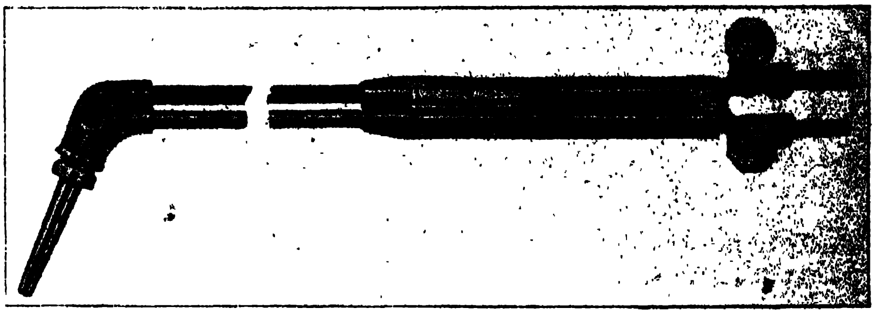
Safety in Grinding

Two unique attachments for use with an ordinary foundry stand grinder are shown in the accompanying illustration. These were devised by T. F. Jennings, foundry superintendent for the Utah Copper Co., Garfield, Utah. An adjustable sliding table is set immediately in front of the two wheels of a double stand grinder. This table may be moved forward or backward and tightened in position by a countersunk bolt. The table has been in use for about three years and since its adoption no instance has been noted where the work wedged, scalped or choked in the wheel. The workman is enabled to place a casting on the table and all the energy expended is pressing the work against the rotating surface of the wheel. Ordinarily, the combined weight of the casting and the pressure necessary to hold it against the wheel causes



ADJUSTABLE TABLE AND GLASS SHIELDS PROVIDE SAFETY FEATURES FOR GRINDING WHEELS

fatigue which is avoided through the assistance furnished by this device. It is possible to use a large wheel on one side and a smaller on the other if desired, as one side of the table may be advanced to compensate for the different diameters. The glass shield attached to the wheel guard is another device intended to be used with or without goggles to guard the workman's sight. The rigid construction of this guard combined with the hinged adjustable feature furnish a convenient shield for the workman's face against any flying particles. The pulley and belt have been fitted with a special guard since the photograph was taken.



WELDING TORCH DESIGNED TO ELIMINATE BACKFIRING—SMALL NUMBER OF INTERCHANGEABLE PARTS COMPOSE EQUIPMENT

Welding Torch Embodies New Features

A new welding torch, which embodies a number of unusual features, has been developed by the Air Reduction Sales Co., New York. The torch consists of an unusually small number of parts, some of the threaded connections prevalent in earlier models of welding torches being eliminated. The torch heads are drop-forged of the same material as the tip, so that both parts are subject to the same coefficient of expansion and contraction. In order that operators cannot make the mistake of connecting the feed hose to the wrong connection the oxygen valve is equipped with a right hand thread and the acetylene valve with a left hand thread, the nuts on the feed hose having corresponding threads. The handle is knurled and bears a stamped gas pressure table which serves as a permanent source of information for the operator. The valve handles are of octagon shape and are on the left side of the torch. It is claimed that on account of the manner in which the gases are mixed this torch will not backfire.

Magnesite in the United States

Magnesite is mined in only two states in the United States and most of the output is used in steel-making plants and for the manufacture of refractory products and sanitary flooring. The domestic producers of magnesite suffered serious handicaps in 1918 by reason of restrictions on freight shipments, of the increase of the imports of magnesite from Canada from 3000 tons in 1917 to 20,000 tons in 1918, and of the use of substitutes for magnesite. Many of the producers who were not equipped with kilns lost business because the makers of magnesite refractory products insisted on having calcined or deadburned material, which is so much lighter in weight than raw magnesite that its shipment saves half the freight charges.

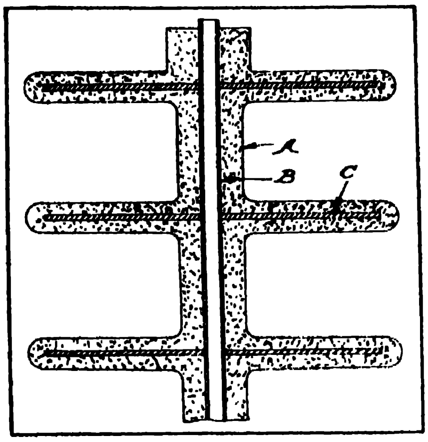
The country from which we imported most of our magnesite before the war was Austria-Hungary.

A report on "Magnesite in 1918," an advance chapter of the volume "Mineral Resources of the United States" for that year, has just been issued by the United States geological survey, department of the interior, and can be obtained free of charge on application to the director of the survey at Washington. The chapter, which was prepared by R. W. Stone and C. G. Yale, states the general condition of the industry, the prices, production, imports, and uses, gives many analyses of magesite, and describes briefly the foreign deposits.

Patents Drying Method

With the object of making cores that can be quickly dried without placing them in the core oven, a Michigan inventor, Alexander W. Finlayson, recently devised the core shown in the accompanying illustration. This core is patented.

In the ordinary method of making cores, the inventor claims that the baking process does not eliminate all the moisture from the core with the result that the molten metal generates a certain amount of vapor.



CORE PROVIDED WITH A PERFORATED TUBE FOR CARRYING AWAY VAPOR

In the accompanying illustration the core is shown at *A*, which is formed around a perforated tube, *B*, while *C* are baffle plates imbedded in the core. While the core is in a green state, it is moistened with gasoline which is ignited. As the liquid burns, the inventor points out that the heat generated is sufficient to dry the surface of the core rendering it fit for contact with the molten metal. A substantial saving of time is claimed. Vapor in the interior of the core, caused by the heat of the molten metal, is carried off by the perforated tube *B*. It is said that this effectually eliminates blowholes in the casting which, of course, would result if, no means were provided for disposing of the vapor as it is generated.

Portable Appliances for Drying Ladles

An improvement on the old wood fire for drying ladles is shown in two types in the accompanying illustration. The manufacturers state that the equipment shown at the left will dry a 50-ton ladle in 15 minutes. It consists of a 20-gallon steel oil tank, equipped with 150-pound pressure gage, oil and air regulating valves, one length of special oil resisting hose and one length of high pressure air hose, a burner with a long handle and deflecting plate. The tank is mounted on a strongly built angle iron truck which has handles and can be moved easily from place to place. It is supplied with two 18-inch wheels and two smaller guide wheels. Attached to the truck is a swinging davit, from which the burner with the deflecting plate is suspended by a steel cable. This plate may be lowered or raised as desired, by a steel cable connected to a small winding crank on the truck. The burner lights instantly, burns fuel, crude or kerosene oil and operates with compressed air from 20 to 100 pounds pressure. The flame of the burner is directed down toward the bottom of the ladle. It spreads evenly and quickly, and heats the sides and bottom of the ladle.

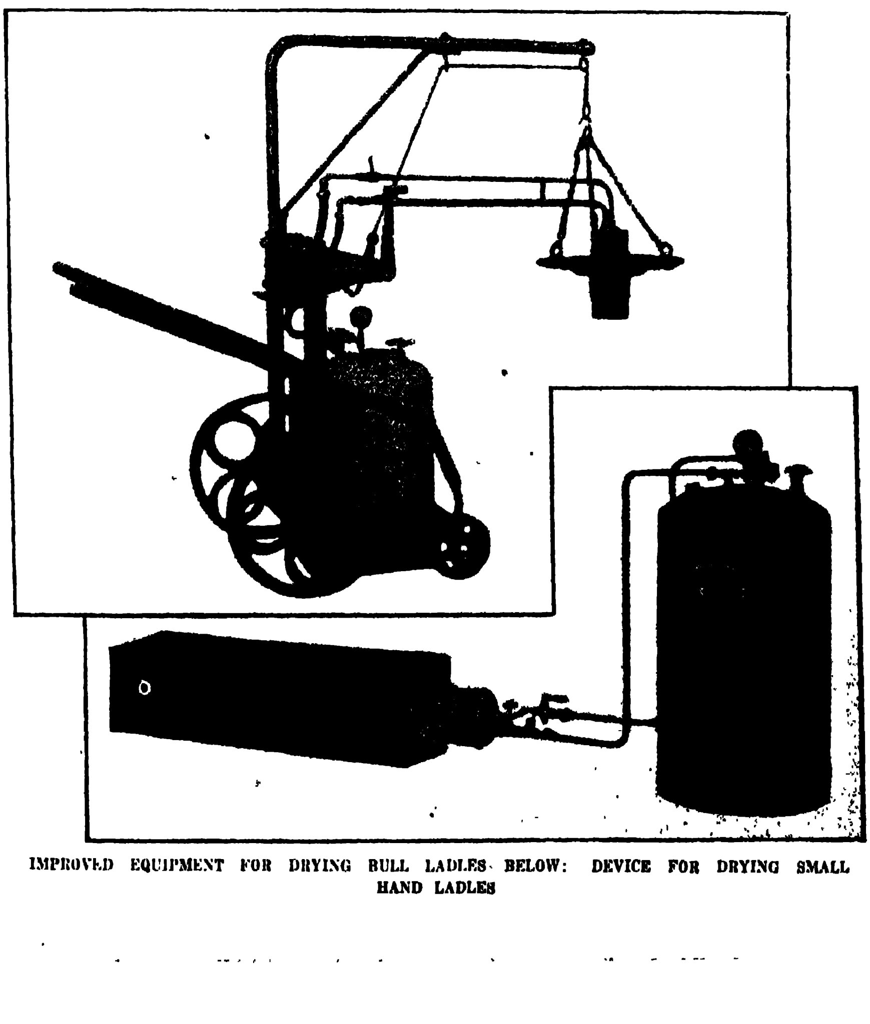
The other apparatus shown in the same illustration is designed for drying small ladles. It consists of a sheet iron box reinforced with angle iron and lined with fire brick, a furnace burner and a 20-gallon steel oil tank. The ladles are placed bottom up over the opening of the box and the flame of the oil burner shoots up through the openings, quickly and evenly drying the lining of the ladles. The fire box can be made any desired length to heat a number of ladles. The burner consumes any grade of fuel, crude or kerosene oil in connection with compressed air from 20 to 100 pounds pressure. This outfit is supplied with a regulating valve and mounted on a flange which is bolted to one end of the box. The steel tank is equipped with a 150-pound gage, oil and air regulating valves. The connections between the burner and the tank can be made with pipe. These installations have been developed recently by the Hauck Mfg Co., Brooklyn, N. Y.

Obituary

Arthur J. Storm, New York representative of the Dayton Foundry Co., Dayton, O., died of heart disease recently at his home in Flatbush, Brooklyn. Mr. Storm was 46 years of age.

William H Perrin died at his home in Pittsburgh recently. Born in Maryland 72 years ago he moved to Pittsburgh and for more than 40 years was connected with the Phillips & McLaren Co. of that city, having been foreman of the company's machine shop and foundry.

Benjamin F. Compton, for the past 10 years superintendent of the brass foundry of the Bethlehem plant of the Bethlehem Steel Co, died recently at his home in Bethlehem. Mr.



IMPROVED EQUIPMENT FOR DRYING BULL LADLES BELOW: DEVICE FOR DRYING SMALL HAND LADLES

Compton was 62 years of age. Prior to coming to Bethlehem he had charge of the brass foundry of the William Cramp & Sons Ship & Engine Building Co., Philadelphia.

W. Cromwell Gurney, president and general manager of the Gurney Foundry Co., Toronto, Ont., died recently. Mr. Gurney was the eldest son of the late Edward Gurney, founder of the Gurney Foundry Co. He was 46, was born and educated in Toronto, and had been connected with the Gurney Foundry Co. since he entered upon commercial activities. He was a member of the Canadian Manufacturers' association. He is survived by his widow, one son and two daughters.

George W. Johnson, head of the Johnson Bronze Co., New Castle, Pa., died Oct. 12, at his home in that city He was born in Clarksville, Mercer county, Pa., 72 years ago and moved to New Castle in 1880 He conducted the Arethusa Iron Works from 1885 to 1899 when it was sold to the American Sheet & Tin Plate Co. Mr. Johnson had large interests in quarries and mines in Lawrence, Butler, Armstrong and Blair counties in Pennsylvania as well as in Maryland and in West Virginia.

Bernard Theodore Burchardi, vice president of the American Machine & Foundry Co., Brooklyn, N. Y., died recently at his home in that city, aged 70 years. Mr. Burchardi came to this country from Germany nearly 50 years ago. He built the great ocean pier at Palm Beach, Fla., and later constructed the Florida East coast and the Florida West railroad and also the Gulf stream road. Mr. Burchardi became general manager of the American Machine & Foundry Co. in 1902 and designed the building occupied by this company He was president of the Wahlstrom Tool Co., and was interested in other corporations which he served in various executive capacities.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

Construction of a 1 story pattern shop is contemplated by the Lidgerwood Mfg Co, Newark, N. J.

Erection of a foundry and machine shop at the Charlestown navy yard is under contemplation.

Orders have been issued for dismantling the Dantzler Foundry & Machinery Co., Gulfport, Miss

Erection of a foundry, 80 x 200 feet, is contemplated by the Windsor Foundry Corp, Windsor, Vt

Erection of a foundry at 4514 Forty-sixth street Seattle, is being planned by James Muir

Woodrue & Edwards, Elgin, Ill, contemplate the erection of a foundry addition, 85 x 132 feet.

An addition to its foundry is contemplated by the Taylor Forbes Co, Ltd., Guelph, Ont.

The Yates & Johnson Co, Chippewa Falls, Wis., is erecting a gray iron foundry and a machine shop. The main building will be 100 x 225 feet.

The Gary Foundry & Machine Co, Gary, Ind, recently changed its name to the Calumet Foundry & Machine Co.

The F. & H Foundry Co, Newark, N. J, recently was incorporated with $60,000 capital, by Christian Franz, William Hewitt and Lena F. Moree.

Plans are reported being prepared for the erection of a foundry, 144 x 365 feet, for William Neiman, Hamburg, Pa

The Engman Matthews Range Co., South Bend, Ind, is reported planning to move its plant to Goshen, Ind.

Bids have been taken for the erection of a brass foundry for the Edro-Richardson Brass Co., 318 North Holiday street, Baltimore.

An increase in capital from $50,000 to $100,000, recently was made by the Rushville Stove Co., Rushville, Ind.

The Rell Tool Steel Foundry Co., Plymouth, Mich., has been chartered with $5000 capital, by Oliver Goldsmith and others.

The Jackson Stove & Stamping Co., Jackson, Mich, has been incorporated with $200,000 capital, by Walter V. Sherwood and others.

Construction of an addition, 50 x 75 feet, is planned by the Roesch-Kohl Enamel Range Co., Belleville, Ill.

The board of directors of the Liberty Foundry & Mfg. Co., Plymouth, Mich., have authorized an increase in capital, from $25,000 to $50,000.

Work has started on the erection of a foundry, 60 x 120 feet, for the A. Garrison Foundry Co., Pittsburgh.

The National Wire Wheel Works, Inc., 625 Equitable building, Baltimore, has been incorporated to do a general machine shop and foundry business, by Ell Frank, C. John Beeuwkes and Bernard R. Youngman

The Bridgeport Brass Co, Bridgeport, Conn, has awarded a contract for the erection of an addition to its foundry, 120 x 220 feet.

Contracts have been awarded for the erection of a foundry addition, 62 x 204 feet, for the American Hardware Corp, New Britain, Conn.

Plans have been drawn for the erection of a foundry, 80 x 140 feet, for the Standard Foundry Co, Buffalo

The Canton-Detroit Foundry Co, Canton, O, recently was incorporated with $50 000 capital, by A E McCuskey, Willard J Frey and others

The Springfield Foundry Co, Springfield, Mass., has awarded a contract for the erection of a 27 x 66-foot plant addition.

The King Foundry Co., St. Joseph, Mo, contemplates the erection of an addition to its plant O M King is president of the company.

Contracts have been awarded for the erection of a foundry, 42 x 82 feet, for the Franklin Machine Co., Providence, R. I

The Progressive Brass Mfg Co, Kansas City, Mo, is having plans drawn for the erection of a foundry, 83 x 150 feet.

The Eastern Iron Products Co., care of the West Side Foundry Co, Troy, N. Y., has had plans prepared for the erection of a plant, 60 x 400 feet.

The Pettibone-Mullekin Co, 110 South Dearborn street, Chicago, has awarded a contract for the erection of a foundry, 151 x 243 feet.

The contract for the erection of a foundry addition to the plant of the Packard Motor Car Co, Detroit, has been awarded to the H. G. Christman Co.

Work has started on the erection of a foundry building, 80 x 200 feet, for the Hamilton-Beach Mfg. Co., Racine, Wis.

Contracts have been awarded by the James Mfg. Co, Ft. Atkinson, Wis., for the erection of a foundry unit, 400 x 600 feet.

The Washington Molding Foundry & Machine Co., Washington, Pa., is reported planning the erection of a new foundry and cupola.

A site has been purchased at Louisville, Ky., by the Illinois Malleable Iron Co., Chicago, on which it plans to erect a modern plant.

Erection of an addition to its foundry, 83 x 222 feet, is reported being contemplated by the Crompton & Knowles Loom Works, Providence, R. I.

The Standard Foundry Co, Racine, Wis., has increased its capital from $50,000 to $100,000. The new issue of stock will be used for the development of the company's facilities.

The Superior Brass Foundry Co, Milwaukee, recently was organized with $15,000 capital, by Frank Schedeler, Philip Lecher and H. H. Wheeler.

Construction of a gray iron foundry, 80 x 120 feet, is progressing for the Walker Mfg. Co., Racine, Wis

The Crosby Steam Gauge & Valve Co, Boston, contemplates the erection of an extension to its foundry and an office building addition.

The Lakewood Foundry Co., Cleveland, recently was incorporated with $20,000 capital, by M. Garber, A Goldman, Engineers building, and others

Erection of a foundry is reported contemplated by the Albert Lea Tractor & Mfg. Co., Albert Lea, Minn.

Plans are being prepared for the erection of a foundry, 60 x 100 feet, for the Security Stove Mfg. Co, Kansas City, Mo.

Jenkins Bros., Ltd, 103 St. Remi street, Montreal, Que, have started work on the erection of a foundry

Contracts have been awarded for the erection of a foundry, for the Southern Stove Works, Inc., Hermitage road, Richmond, Va.

Architects have completed plans for the erection of a foundry, 70 x 90 feet, for the A. N. Peterson Co, Long Island City, N. Y.

Plans have been prepared for the erection of an addition, 65 x 120 feet, to the foundry of the Eagle Foundry Co., Minneapolis. H. D. Asleson, 3055 Fifteenth street, is engineer in charge.

Plans have been completed for the erection of a foundry, 150 x 250 feet, for the Haywood Foundry Co., Indianapolis. An electric crane will be included in the equipment.

Erection of a new core room, 50 x 100 feet, and a foundry building extension, 45 x 60 feet, is progressing at the plant of the H. P Deuscher Co., Hamilton, O.

The Mt. Vernon Foundry Co., Mt. Vernon, O, has purchased a site for a new building from the Mt. Vernon chamber of commerce. Erection of a $20,000 building on the site is contemplated.

The Fine & Sternhell Co., New York, foundry and factory supplies, recently was incorporated with $7500 capital, by S. Fine, A. Sternhell and H. Vogel, 208 West 115th street.

Among the recent incorporations is that of the Wymarsh Foundry, Inc., Hornell, N. Y. The company, which is capitalized at $30,000, was incorpo-

rated by F. A. Wygant, O. H. Martin and C. E. Shults.

Capitalized at $3000, the Loucks Mfg. Co., Sault Ste. Marie, Mich., recently was incorporated to manufacture machinery by Stanley D. Newton, Frederick Loucks and others.

Contracts have been awarded, both for construction and equipment, of a plant addition for the Benton Harbor Malleable Foundry Co., Benton Harbor, Mich. The building will be 80 x 200 feet.

The Millville Cast Iron Products Corp., 419 Market street, Camden, N. J., recently was incorporated to manufacture castings, etc., with $50,000 capital.

The Terminal Pattern & Model Works, Mulberry and Park streets, Newark, N. J., has awarded a contract for the erection of a plant addition, 3-stories, 25 x 99 feet.

Erection of a shop addition, 80 x 88 feet, to be used as a core room, is contemplated by the Atlas Foundry Co., Thirty-eighth and Burnham streets, Milwaukee.

Work on the erection of an addition to the plant of the Keeler Brass Works, Grand Rapids, Mich., is progressing. The building will be 75 x 100 feet.

The Anderson Foundry & Machine Works, Anderson, Ind., is reported planning the erection of a plant, 80 x 200 feet. W. N. Durkin is president of the company.

The Pfau Mfg. Co., Norwood, O., is having plans prepared for the erection of a foundry, 60 x 225 feet. Harry Hack, Telephone building, Cincinnati, is architect.

The Coshocton Iron Works, Monongahela City, Pa., is having plans prepared for the erection of a foundry, 158 x 300 feet. Construction will not be undertaken until next year.

The Minerva Engine Co., Cleveland, has purchased a site on which it plans to erect a plant, the first unit of which will be used for assembling engines and will contain a machine shop. A gray iron foundry will be erected later.

A contract has been let by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., for the erection of a 72 x 102-foot machine shop and a 1-story hardening building. A foundry building will be erected later.

H. A. Lengfelder, president of the Orbon Stove Co., Belleville, Ill., is organizing a company at Birmingham, Ala., for the manufacture of stoves and stove castings. The company will be capitalized at $250,000.

The Remmel Mfg. Co., Kewaskum, Wis., has been organized with $50,000 capital to succeed the machine shop and foundry business of Nicholas Remmel. Additions to both foundry and machine shop are contemplated.

John E. Jordan, Grafton, Mass., formerly superintendent of the Standard Foundry Co., Worcester, Mass., has purchased the Pero Foundry Co., Worcester, Mass., and reopened it after a shutdown due to the molders' strike in that city.

A recent incorporation is that of the Allis Mfg. Co., Milwaukee. The company, which is capitalized at $50,000, will manufacture brass and bronze castings. Paul M. Kuder, Otto J. Juttner and John Garvey are the incorporators.

Moore Bros. Co., Joliet, Ill., manufacturer of stoves and furnaces, is about to start the construction of an addition to its foundry. The building will be 100 x 200 feet, and when completed will be devoted to the production of gray iron castings.

Organization of the Midway Foundry Co., St. Paul, with $100,000 capital, recently was announced. The company will build a plant on University avenue and will manufacture gray iron castings. J. H. Anderson, C. H. Wagner and T. Kaysen Jr. are officers of the new firm.

Shipyard and general jobbing work, as well as the manufacture of brass and aluminum castings, will be engaged in by the West Foundry Mfg. Co., Williamstown, N. J. The company plans to erect a modern plant. C. A. West, formerly of A. Booth Sons Co., is general manager of the new company.

A new corporation recently formed, is that of the Zobell Electric Motor Corp., Garwood, N. J., manufacturer of motors, etc. The company was incorporated in New York last April with $250,000 capital, but has opened a plant at Garwood, N. J. Officers of the company are: President, Fred G. Bell; treasurer, A. T. Zorbisch and secretary, F. E. Bucker.

In order to develop the production of tractors, the Traction Engine Co., Boyne City, Mich., recently increased its capital from $75,000 to $150,000. The company has enlarged its plant and remodeled the foundry of the Conrad Iron Works. E. M. Ackerman, secretary, has stated that no new equipment will be needed before mid-winter or early spring.

Incorporated for $250,000 in Ohio, a branch of the Lumen Bearing Co., Buffalo, is preparing to build a brass casting plant in Youngstown, O., for the manufacture of bronze bearings. The plant will include, smelting, refining, brass, bronze and aluminum foundries, a machine shop, tool room and grinding room departments. H. P. Narrock is general manager and W. H. Barr is president.

The Link-Belt Co., Chicago, is erecting an addition to its foundry at Indianapolis, which consists in completing a new furnace building. For the present only one furnace, which will be of 15 tons capacity, will be installed. Necessary machinery, such as rolling mills, sand blast and other foundry equipment; is now being purchased. The building will be 70 x 400 feet.

New Trade Publications

ZINC DUST.—This material is described in an 8 page booklet recently published by the New Jersey Zinc Co., New York. Two grades are described in detail, one being said to contain 95 per cent metallic zinc, while the metallic zinc content of the other averages between 92 and 94 per cent. The uses to which this material can be put are given.

SAND BLAST EQUIPMENT.—A 28 page booklet devoted to sand blast equipment has been prepared by the American Foundry Equipment Co., New York. The installations described include rotary table rooms, automatic tables, revolving barrels, blast cabinets, pressure tanks, dust arresters and accessory equipment. Each is fully illustrated.

CORE OVENS.—Catalog No. 118 recently published by the Whiting Foundry Equipment Co., Harvey, Ill., is devoted to a description of core oven equipment in general. Ovens equipped with three types of doors are described and illustrated. Core oven racks, core maker's benches, puller machines, core oven cars and trucks, etc., are among the equipment described. Illustrations of actual installations are given.

CORE OVENS.—The Ohio Blower Co., Cleveland, has published an 8 page bulletin, in which core ovens, core cars and racks and rotary ballbearing ventilators are described and illustrated. Complete data are given concerning each product and numerous illustrations, showing typical installations, etc., supplement the descriptions. A temperature chart taken on one of these ovens is given as a supplement to the booklet.

ROTATING ELECTRIC FURNACES.—The Booth Electric Furnace Co., 53 West Jackson boulevard, Chicago, has issued a four page bulletin covering details of construction and data of operation of a rotating furnace for melting nonferrous metals by the electric arc. Details of a test made by the Commonwealth Edison Co., Chicago, are included and many figures showing cost of operation as compared with melting with other fuels. Figures are also given showing cost of melting various metals.

PANEL BOARDS.—Bulletin No. 47942, devoted to a description of safety panel boards and cabinets, is being distributed by the Sprague Electric works of the General Electric Co., New York. These panel boards are applicable wherever the live front type of panel board may be used. Branch circuit switches and main switches are said to be distinctive features. They are simple in design and are positive in action. The blades of the branch circuit switches make direct contact with the branch connection bars, and the brushes of the main switches make direct connection with the main buses, providing the minimum number of electrical joints. The booklet gives full specifications and other data, together with a number of excellent illustrations.

UNDER FEED STOKER.—A 16-page booklet in which an automatic under-feed stoker is described and illustrated, recently was published by the Universal Automatic Under-Feed Stoker Co., Johnstown, Pa. The booklet explains in simple language the operation, etc., of the stoker. This nontechnical description, which is a deviation from the usual descriptions of similar appliances, will enable the average person to understand the workings of the equipment. The stoker is applicable to many types of furnace, including not only water tube, fire tube and various marine boilers, but also metallurgical furnaces for heating or melting ferrous and nonferrous metals, kilns, dryers, etc. Excellent illustrations supplement the description.

STANDARDIZED BUILDINGS.—The Milliken Bros. Mfg. Co., New York, has published a descriptive catalog in which structures designed by the company under the standardized truss unit system are described and illustrated. These buildings are all-steel and are furnished complete with doors, skylights, etc. They are suitable for all classes of industrial and manufacturing structures. The booklet is profusely illustrated showing buildings erected for the United States government and large manufacturers. One section is devoted to transmission towers, radio towers and special poles, which the company also builds. A companion booklet, has been also issued by the company. This booklet forms a guide to the construction of buildings from foundation to roof.

ELECTRIC BRASS FURNACE.—A bulletin entitled, "Electric Furnaces in the Brass Rolling Mill," has been published by the Electric Furnace Co., Alliance, O. It contains a number of illustrations, several of actual installations, and a description of an electric furnace which the company manufactures. The furnace described is of the standard resistance type. It is rated at 105 kilowatt in electrical capacity, has a hearth capacity of 1500 to 2000 pounds and a melting time of two hours. The cylindrical shell of the furnace is supported in front upon cast iron trunnions and in the rear by a screw which may be raised and lowered by a motor placed beneath the floor. A bowl shaped hearth, located in the bottom of the furnace, is lined with plastic material and is contained in a steel pan. The maximum capacity of the hearth is said to be a one-ton charge. Other data pertaining to the furnace are given.

ELECTRIC HOISTS.—A brief description of the salient points of a line of electric hoists manufactured by the Victor R. Browning Co., Cleveland, is given in an 8-page booklet, which the company recently published. According to the booklet, this line of hoists is built for use in structural shops, automobile factories, foundries, machine shops, loading platforms and other industrial works where continuous rough use is encountered. Some of the features of these hoists, as pointed out by the catalog, are: The cast iron hoist drum has all surfaces machined and contains deep grooves to receive the cable; the removal of six cap screws gives access to the compact controller, which can be removed as a complete unit; heat treated gears and disk load brake occupy an individual compartment and operate in oil; the motor, which operates on ball bearings, is contained in a separate compartment and is protected by a steel plate. Other parts of the hoist are described and the numerous illustrations are given.

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Making Rubber Mold Castings

Situated in a City Acknowledged to be the Greatest Rubber Manufacturing Center in the World, Iron Foundries Have Developed Special Facilities for Producing the Required Castings

BY PAT DWYER

WHEN the immortal bard penned the lines "There is a tide in the affairs of men which taken, at the flood leads on to fame and fortune," and put them in the mouth of the man who conspired against mighty Caesar, he gave utterance to a thought and put into words a sentiment that antedated by many centuries the stirring days of the Roman empire. The truth of the sentiment has been exemplified in every age and in every land and perhaps in none more frequently than in these United States of America during the past century. 'Tis true that when Marcus Brutus expressed himself he had in mind certain warlike deeds, but it is also true that there are numerous instances of men who believed as he did and launched themselves on the uncertain tide of commercial and industrial life without any assurance that the tide was on the flood and would bear them into the haven of success and security. The careers of the late Andrew Carnegie and H. C. Frick are cases in point. They embarked on the tide when it was just beginning to flow and with other sturdy navigators found themselves carried along on a flowing flood of steel which yielded them for-

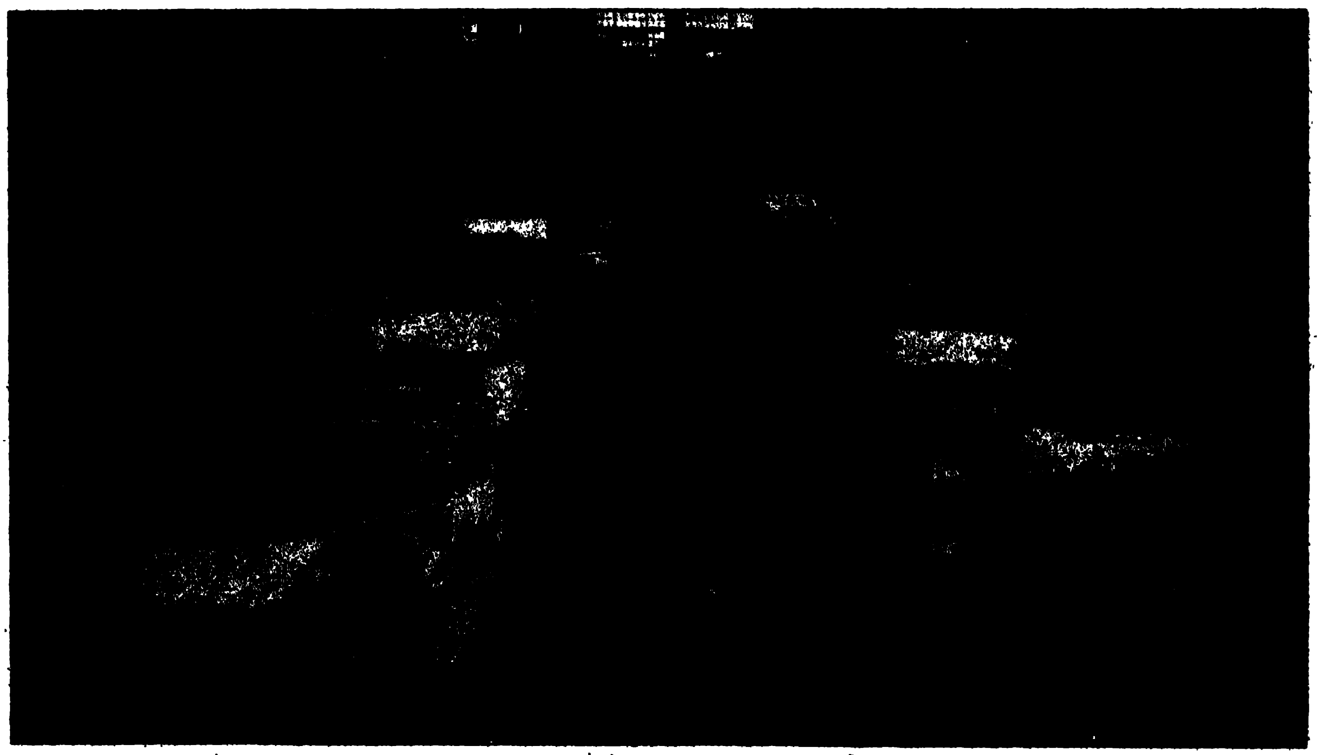


FIG. 1—A FLOOR OF MOLDS FOR AUTOMOBILE TIRE CORES—THE LUGS AT THE SIDES OF THE FLASKS ARE TAPERED AND NO WEDGES ARE NEEDED TO TIGHTEN THE CLAMPS

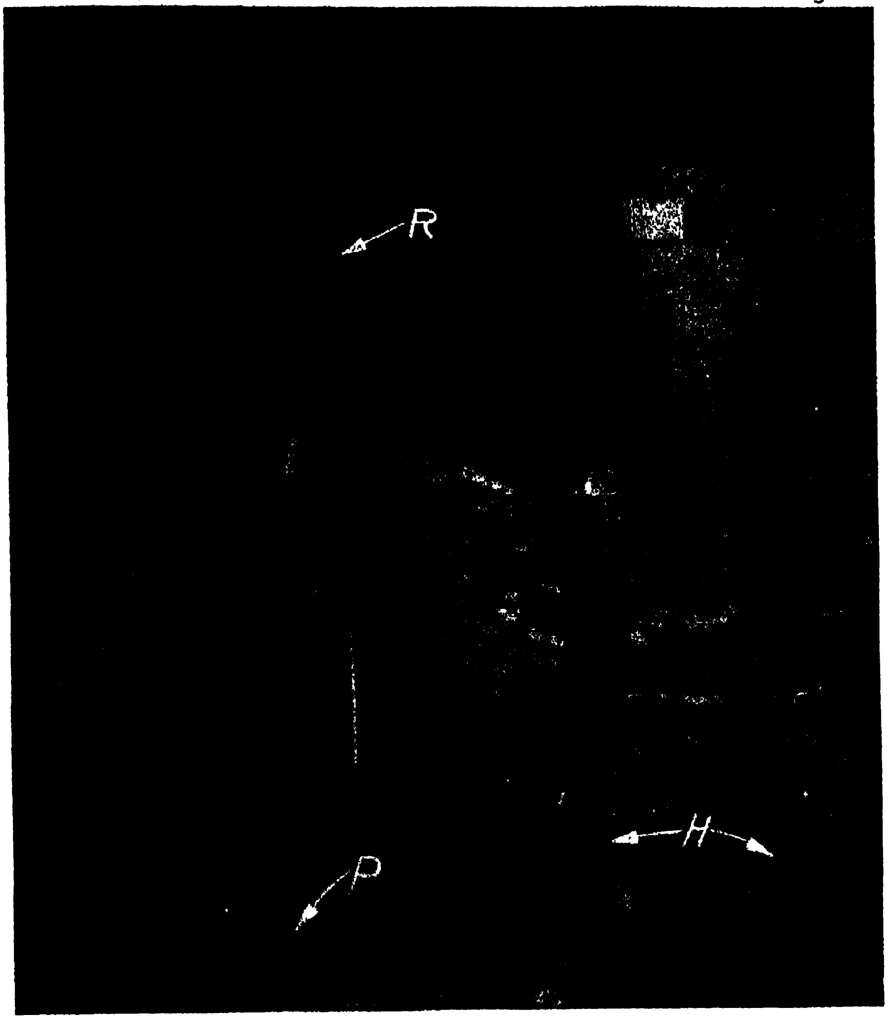


FIG. 2—THE ROLL PIT IN WHICH LONG CYLINDRICAL CASTINGS ARE MOLDED AND POURED

tunes unparalleled in the history of the world.

Since the base of all industrial life rests on iron it is only natural to find that the growth and expansion of the huge industrial enterprises have had a corresponding effect on the casting industry. Iron, steel, coal mines, railroads and motor car factories all need castings to carry on their operations and many foundries trace their origin, subsequent progress and growth to the expansion of the particular business to which they cater. Within the past decade immense rubber factories have been established at Akron, O., for the manufacture of automobile tires and their casting requirements absorb the output of several foundries.

Tire Molds Prove Attractive

Attracted by the possibilities of the business in the early days, four molders and a coremaker organized the Atlantic Foundry Co., in 1905, and leased a small foundry of 5 tons capacity. At the end of six years the company owning the property and needing it for their own use brought the lease to a close. The Atlantic Co. then built a new foundry of about 15 tons capacity on the premises where it now is located. An addition was built to the new shop at the end of two years and when two years more had elapsed the business had grown so much that a still larger addition was found necessary. In 1917 the company purchased the buildings of the Ford Foundry & Heating Co., Cuyahoga Falls, O., and now operates both plants. In 1918 a steel foundry, 100 x 100 feet, was built and equipped at an approximate cost of $250,000 for the production of electric steel castings.

Although built on a plot of ground adjoining that on which the iron foundry is situated it is operated independently and is a complete self-

FIG. 3—WHERE THE COPES ARE MADE, SHOWING A FINISHED COPE, A CORE, ONE OF THE PATTERN BOARDS AND THE JAR MACHINE

contained unit. The steel is melted in a 3-ton Snyder electric furnace manufactured by the Industrial Electric Furnace Co., Chicago. A monorail track is used for carrying the material for the charge from the yard to the furnace.

The company which started out so modestly a few years ago, today is capitalized at $500,000 and does a business of $1,000,000 a year. Of the five original incorporators three men, the president and two vice presidents, still are interested actively in the management of the company.

How Tires Are Made

Automobile tires are made in iron molds. The process varies in some particulars depending on the style of tire and the established practice in different factories. It may be described briefly as follows:

A hollow cast iron ring conforming to the inside shape of the tire, either in one or four pieces, is mounted on a revolving spindle and the fabric for the tire is stretched upon it and pressed down closely by a series of rollers. The tire, with the cast iron core still in place, is taken off the machine and lowered into a cast iron half mold which is to form the outside surface and also indent the figures of the wheel tread. An upper half mold which has been suspended is lowered and then the entire load with several others is delivered to the vulcanizing vessel where it is brought to a predetermined heat and then squeezed by a hydraulic press.

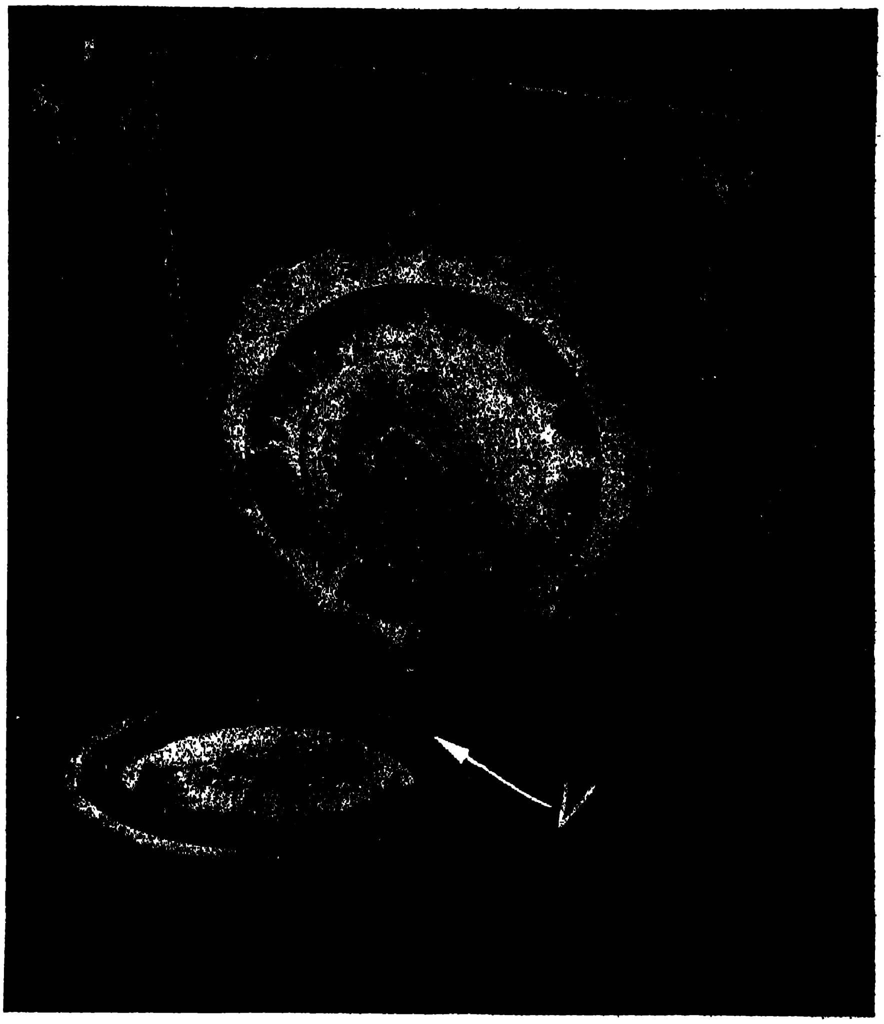


FIG. 5—MOLD READY FOR CLOSING, SHOWING STYLE OF STRAINER GATE AND VENT

The method the Atlantic Co. follows in making the castings for the interior core of the tires is shown in Figs. 3 and 5. It is interesting to note that a gang of six men make 50 molds a day. The gang is composed of one crane man, one coremaker, one man coring the molds and making up the runners, one man

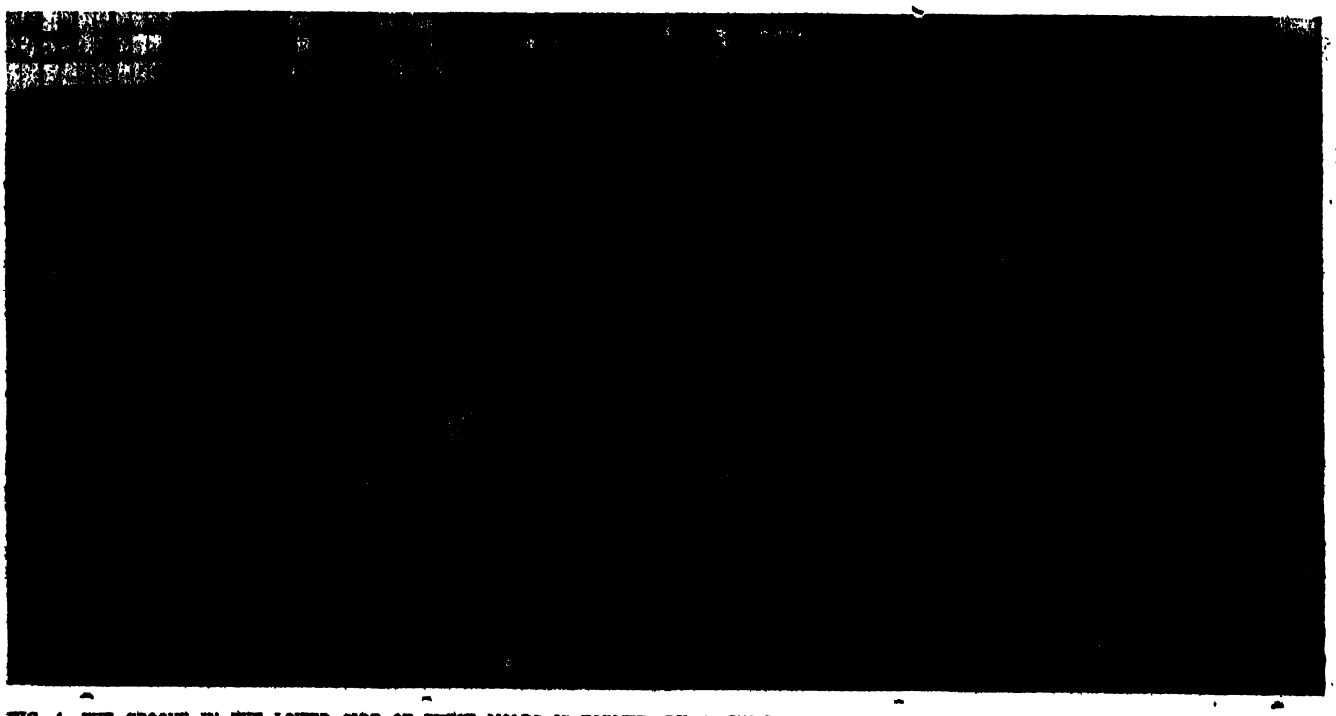


FIG. 4—THE GROOVE IN THE LOWER SIDE OF THESE MOLDS IS FORMED BY A CHILL RING WHICH SERVES TO CLOSE THE GRAIN OF THE IRON

ramming drags and two men making copes. All the operations in connection with making these molds have been studied carefully and all surplus or unnecessary labor is eliminated. Making up the runners is a case in point. When the cope is set, the man whose duty it is to look after this part of the job drops a runner stick into the gate, places his runner box and throws in a shovelfull of sand. He then takes a block which is cut to the conventional shape of a runner basin, having a hole near one end to accommodate the gate stick. This block is lowered into the soft sand in the runner box and pressed down firmly. Two more shovelsfull of sand are then thrown into the box and rammed lightly with the shovel handle. The surplus sand is scraped off, the block withdrawn and the runner is ready for the iron.

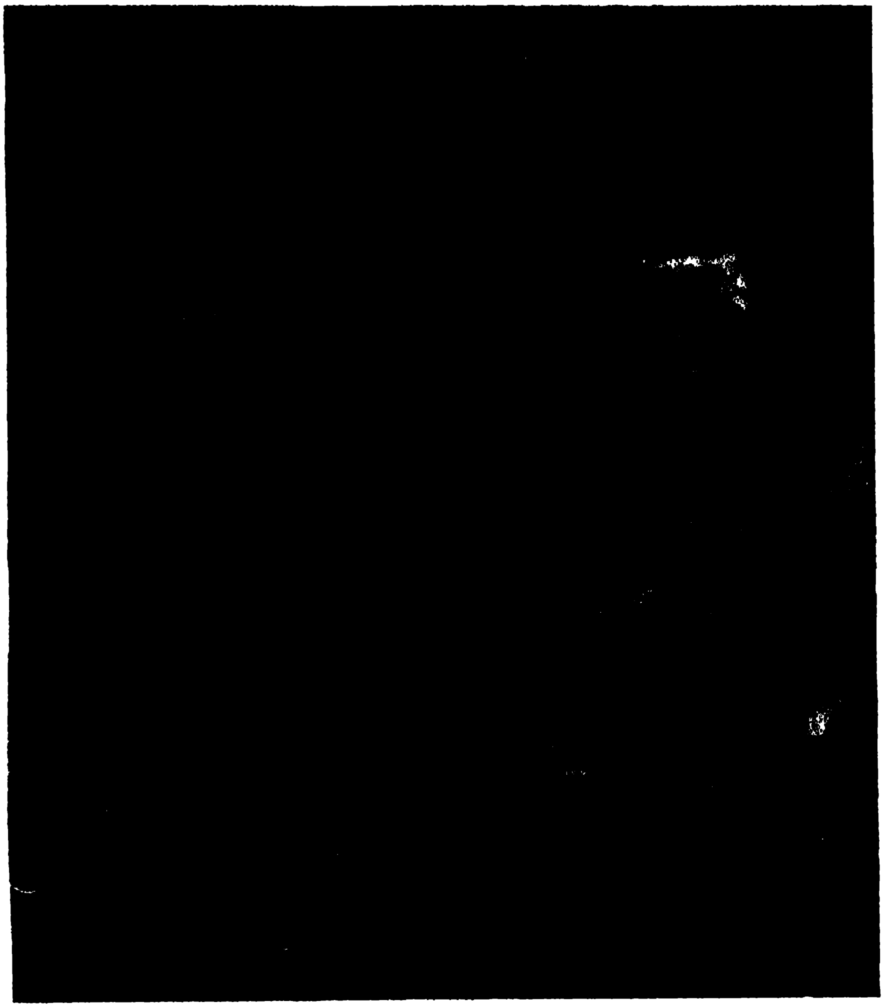


FIG. 6—THIS FLASK HAS SEVERAL SPECIAL FEATURES—NOTE THE SAND STRIP AROUND THE RIM, ALSO AROUND THE CENTER—THE SPLIT IN THE CENTER PROVIDES FOR EXPANSION AND CONTRACTION—DOUBLE PIN LUGS ASSURE ALIGNMENT OF COPE AND DRAG—TAPERED CLAMP LUGS ELIMINATE THE USE OF WEDGES

For greater efficiency and freedom of movement the drag machine is situated at one end of the floor and the cope machine at the other. The drags are barred as well as the copes eliminating the necessity for using bottom boards. When shaking-out the molds at night the sand from all the drags is dumped in a heap near the drag machine and the empty flasks are piled nearby. The same treatment is accorded the copes at the other end of the floor. Long handled, two-prong forks with the prongs bent at right angles are found useful for removing the gaggers from the cope sand pile. No gaggers are used in the drag because the mold board is clamped on and turned over with the flask. One of the cores for the rings is shown at *C*, Fig. 3. These cores are made in halves from an oil sand mixture and pasted. One set of half cores is made first, each half containing a No. 5 gage wire ring for a stiffener. When they are dried they are taken from the oven and each one *topped off* with a green half from the same corebox. To vent this core a narrow channel is cut in the joint of the green half extending for 8 or 10 inches on each side of the print. A short piece of ¾-inch pipe is inserted to form the core print before the two halves are pasted together. As in the case of the hydraulic ram referred to later the short piece of pipe is removed when the casting is cleaned and a plug screwed in the hole before the casting is machined.

The two chief requisites of these castings are that they be close-grained and absolutely clean. They are machined all over and the least blemish is enough to condemn them. The machined sizes are held within the most rigid limits. When they are in use they are scrubbed with steel wool each time a tire is made on them and small as the wear is, it is sufficient to render them useless in a comparatively short time. A tolerance of only 0.006-inch is allowed.

The depression in that part of the mold which is used to form the outside face of the tire is cast against an iron chill. The silicon content of the iron used for these castings averages about 2.50 per cent and, therefore, the face of the casting is not actually chilled as chilling is understood in the foundry. The grain of the iron is rendered quite close and dense, but it can be machined.

The outside surface of hydraulic rams made in this shop are rendered close and dense by a similar process. The molds for these castings are made on end in round iron flasks. Small concave iron blocks, 8 x 8 x 2 inches, a number of which are shown in Fig. 2, are built in tiers up against the pattern and heap sand rammed in between them and the wall of the flask. In other words they simply take the place of the usual thickness of facing sand and as a result when the pattern is drawn the wall of the mold consists of a cast iron skin 2 inches thick. The top part of these castings with the flask removed and the chill blocks still in place is shown in Fig. 2. The entire casting is 18 feet long by 2 feet in diameter with a metal thickness of 3 inches. One end is open and the other end is closed, the closed end is cast down. The casting is shown standing in a pit 14 feet deep, 10 feet long and 6 feet wide. A completed mold for another ram casting is shown standing alongside in the same pit. These castings are poured from the top, eighteen ¾-inch pop gates connecting the mold with the pouring gate.

The core for this type of casting is split longitudinally and made in a half box. The two halves are made, dried and assembled in a horizontal position then the entire core is up ended by one of the cranes and lowered vertically into the mold. Each half of the core is reinforced by four long pieces

of 2-inch pipe and suitable hooks are provided at one end for attaching the crane. Since one end of the casting is closed and furthermore, since this end has to be cast down to insure solidity on the working end of the ram, provision was made for locating and securing the core. The usual alternatives in such cases would have been either to suspend the core from the cope or let it rest on chaplets on the bottom face of the mold. Neither of these plans appealed to the management so another method was adopted which has proved highly effective.

Before the two halves of the core are assembled they are laid side by side horizontally on a pair of horses. The joint of one half is turned up and the joint of the other half is turned down. Each half contains a 4-inch core print 2 feet long in the end which will be down when the casting is poured. This print is provided to hold a piece of 4-inch shafting, 3 feet long, which in turn is destined to center and sustain the weight of the entire core when it is in position in the mold. The short shaft is set in the print of the half core whose joint is turned up. The inner end is brought in to contact with a short iron plate which has been rammed up in the core for that purpose, while the other end projects about 12 inches. Paste is applied to the joint of the core and also daubed on the piece of shaft and then the other half of the core is picked up and lowered on. The two halves of the core are then bolted together, the joint daubed with slurry and the bolt holes filled with sand. The completed core is then given a coat of blacking and run into the oven for a final drying.

After drying the entire core is upended and lowered into the mold. The piece of shafting enters a core print 8 inches deep on the bottom of the mold, *P*, Fig. 2, and supports the weight of the core 4 inches off the bottom and also prevents it from shifting from its central position when the pressure of molten iron comes under it. The piece of shafting is removed with the rest of the core during the process of cleaning the casting and later, when the casting has reached the machine shop, a plug is screwed in the hole. The core is prevented from rising by two short pieces of rails, *R*, Fig. 2, resting on the cope and secured to the bottom of the mold by turnbuckles and hooks, *H*, Fig. 2.

The present foundry building is a substantial brick and steel structure 90 x 200 feet divided into three bays. The center bay is 40 feet wide and is spanned by two electric and one handpower traveling cranes. The 10-ton handpower crane built by the Northern Engineering Works, Detroit, was the first installed and served until the volume of work outgrew its capabilities. It now is kept at one end of the shop where the roll pit is located and is used only when one of the other cranes is not available. There is one 10-ton electric traveling crane with a 5-ton auxiliary hoist built by the Northern Engineering Works, Detroit, and one 15-ton crane also having a five-ton auxiliary hoist built by the Pawling & Harnischfeger Co., Milwaukee. The entire center bay with the exception of a 20-foot space at each end used for cleaning the large castings is devoted to molding a miscellaneous line of castings, the majority of which form parts of the various machines and appliances used in the rubber factories. Considerable outside work also is handled including among other castings, frames for steam hammers.

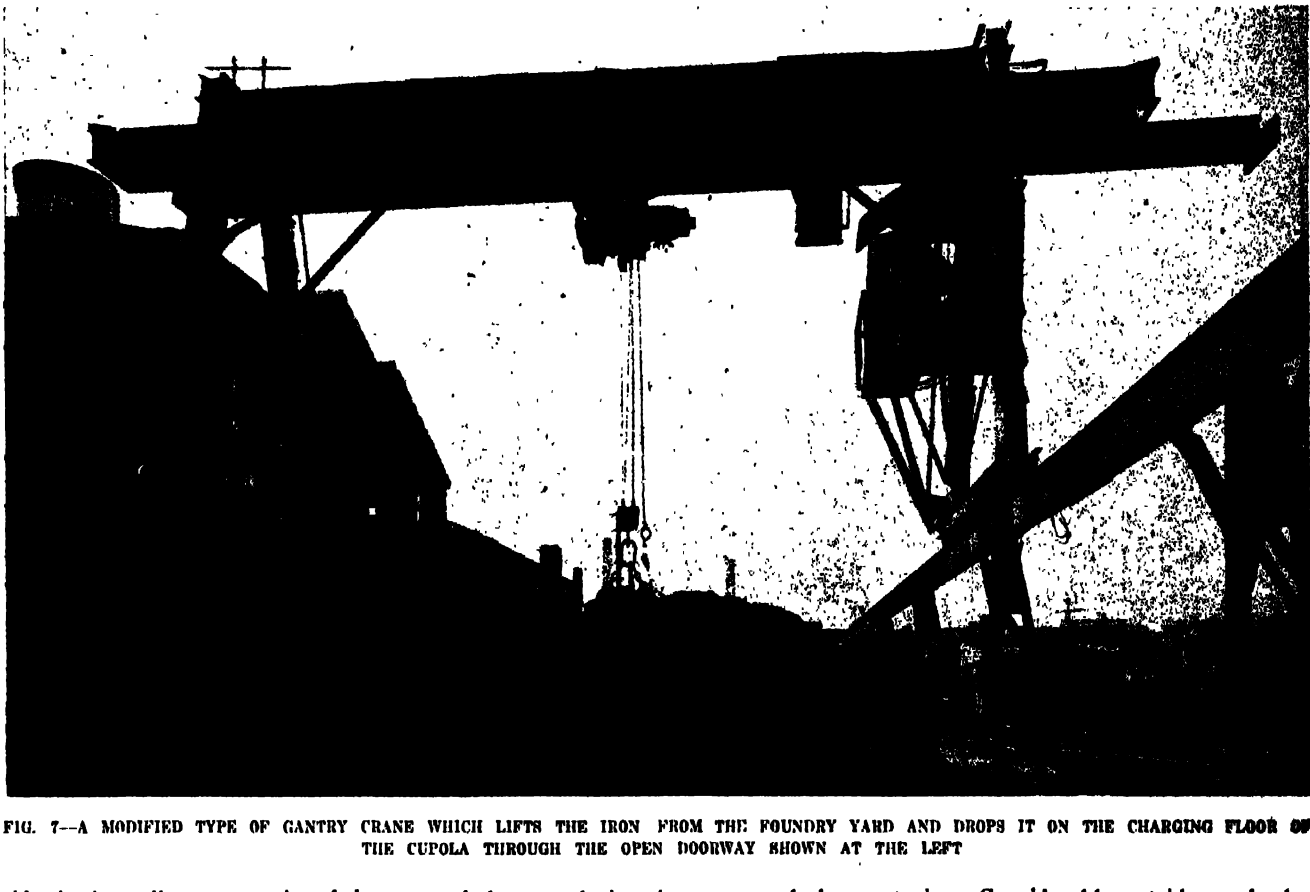


FIG. 7—A MODIFIED TYPE OF GANTRY CRANE WHICH LIFTS THE IRON FROM THE FOUNDRY YARD AND DROPS IT ON THE CHARGING FLOOR OF THE CUPOLA THROUGH THE OPEN DOORWAY SHOWN AT THE LEFT

The west bay of the shop is 30 feet wide. One end for a distance of 30 feet is devoted to bench and snap flask work; a number of benches and other necessary appliances being provided for that purpose. A space of about 50 feet at the opposite end of this bay is devoted to molding odd sizes and short orders of cores for tire molds. The remaining space in this bay is equipped in a special manner for the production of tire molds in quantity.

A general view of the floor taken at 11 a. m. is shown in Fig. 1. A plain jar ram machine made by the Herman Pneumatic Machine Co.

Pittsburgh, is located at one end of the floor and is used for making the drags while a similar machine situated at the other end of the floor is utilized for producing the copes. The flasks are laid down in four rows and the runners built so that two gangways only are required

This bay is provided with a crane runway for the entire length and is spanned by two 5-ton electric traveling cranes, one built by the Northern Engineering Works, Detroit, and the other by Pawling & Harnischfeger, Milwaukee.

Miscellany in East Bay

The east bay is devoted to a variety of uses. A space at the north end is partitioned off to serve as a toilet, wash and locker room for the employes and is equipped with all the necessary facilities including hot and cold water. The core room occupies the greater part of the east bay extending from the wash room to the core ovens. It is not equipped with a crane, therefore, the large, heavy cores for steam hammer frames, hydraulic rams, etc., are made on the molding floor in the center bay adjacent to the core room. A large basement extends under the greater part of the core room floor. It is divided into several compartments and is used for a sand storage. There is a round manhole in the floor over each sand bin. The new sand for molding and coremaking is unloaded from the cars on the railroad siding outside onto wheelbarrows and dumped through the manholes into the bins in the basement. A stairway leads down from one side of the core room floor to a gangway which extends in front of all the basement bins.

When a quantity of new sand is needed a man goes down into the bin holding the required grade of sand and with a shovel pitches a sufficient quantity up through the manhole onto the floor. Round iron cover plates are provided for the holes when they are not in use. It is claimed that this method of storing the sand keeps it in perfect condition. The state of the weather has absolutely no effect on it—a circumstance which will be appreciated by foundrymen who have to thaw out their sand in the winter before it can be used or who have seen their sand piles turn to dust in the summer time. An even temperature is maintained in the basement throughout the year and the sand is always cool and damp.

The remainder of the bay is occupied by the core ovens, blower room, cupolas, tumbling barrels and sandblast installation. A gas fired swinging drawer type oven built by the Monarch Engineering & Mfg. Co., Baltimore, is used for small cores and hurry up jobs. It frequently has been possible with the aid of this oven to make and dry a batch of ring cores in an hour. Each of the two large ovens is 7 x 12 x 28 feet and is fired at present with coke. In addition to long cars equipped with standards and cross rails which enable them to carry four deck loads, the sides of the ovens are provided with racks and shelves upon which an immense quantity of cores are dried every night.

The blower room is on the ground floor adjacent to the cupolas. In it are installed two P. H. & F. M. Roots blowers. The smaller one has not been used since a new and larger cupola was set up. It still is left fully equipped and connected and is held in reserve together with the smaller cupola. The large positive pressure blower is capable of delivering 8000 cubic feet of air a minute and is driven by a 60-horsepower motor made by the Allis-Chalmers Co., Milwaukee. It supplies the blast for a cupola lined to 60 inches and made by the Whiting Foundry Equipment Co., Harvey, Ill. About 30 tons of iron is melted every day.

Delivering Materials

Coke is delivered to the charging floor by an elevator, but the pig iron and scrap are taken direct from the storage piles in the foundry yard by a magnet suspended from a gantry crane and dropped on the charging floor within a few feet of the charging door. The main bridge of the crane travels on a runway which parallels the building; but the auxiliary bridge which is formed of a long 24-inch I-beam has a lateral movement which enables the operator to extend it 10 feet past the end of the upright framework. The trolley carrying the magnet travels on the lower flanges of the I-beam and is controlled independently. This arrangement makes a flexible unit and reduces to a minimum what is generally considered the hardest and most difficult of foundry operations. This crane also carries the coke from the cars to the storage pile by a large bucket provided with a swinging door on the bottom which is tripped by a rope in the hands of a man on the ground. When necessary, the crane is used to operate a drop ball for breaking large pieces of scrap.

For the general run of work the charges of pig and scrap are in the proportion of 40 and 60. They weigh 4000 pounds each with 500 pounds of coke between.

Instructions Sent Out in Bulletin Form

The Foundry Equipment Manufacturers' association organized about a year ago to promote and further the interests of its members by impressing upon foundrymen generally the advantages to be derived from the use of efficient foundry equipment, proposes now to broaden the scope of its activities by conducting a campaign of education on the proper care, maintenance and operation of such equipment after it has been installed.

The members of this association, with their experience covering conditions and problems in all classes of foundries, have been in a favorable position to accumulate facts and data. They now propose to embody this information in a series of monthly bulletins, to be issued during the present year. These publications will be sent directly to the executives, superintendents and foremen of all foundries in the United States and Canada. That they may receive the attention of the men interested, they will be mailed to the home addresses of the plant executives. An adjustable, stiff, cardboard cover will be sent with the first of the series so that the bulletins may be filed as they are received and thus be available for reference. The cover will be of convenient pocket size. Only one individual phase of the problem connected with each piece of foundry equipment will be considered in each of these bulletins. It is stated that they will be written in a concise, practical manner and will contain live operating data on machinery and its care.

The members of the association follow: American Clay Machinery Co., Bucyrus, O.; American Foundry Equipment Co., New York; American Molding Machine Co., Terre Haute, Ind.; Arcade Mfg. Co., Freeport, Ill.; Berkshire Mfg. Co., Cleveland; Beryk Co., Cleveland; Blystone Mfg. Co., Cambridge Springs, Pa.; Buch Foundry Equipment Co., York, Pa.; Cleveland-Osborn Mfg. Co., Cleveland; Federal Foundry Supply Co., Cleveland; Foundry Equipment Co., Cleveland; Grimes Molding Machine Co., Detroit; Hanna Engineering Works, Chicago; H. M. Lane Co., Detroit; McLain-Carter Furnace Co., Milwaukee; National Engineering Co., Chicago; S. Obermayer Co., Chicago; Pangborn Corporation, Hagerstown, Md.; J. W. Paxon Co., Philadelphia; Henry E. Pridmore Co., Chicago; P. H. & F. M. Roots Co., Connersville, Ind.; U. S. Molding Machine Co., Cleveland; Wadsworth Core Machine & Equipment Co., Akron, O.; Whiting Foundry Equipment Co., Harvey, Ill.; E. J. Woodison Co, Detroit; Young Bros. Co., Detroit.

Checking Mistakes in Stock Records

Cupola Charging Sheets are Made Up Each Day Showing the Amounts of Different Materials Used—Entries of Pig Iron Charges are Made On Separate Cards for Each Carload

BY ROBERT STOTT

IN THE FOUNDRY of Dec. 15 there was an article describing a simple system for keeping perpetual inventory. While this article was interesting as far as it went, we think that the author could have profitably told how the records are kept to determine the amount of iron which has been used. This is an important detail of any stockkeeping system, because if an adequate check is not kept to catch any mistakes in weighing, the inventory, on which reliance is placed, may in time be far off from the actual amount of stock on hand. Therefore, details of a system followed by a firm which employs a chemist may be of interest. In this case the chemist keeps most of the records, but the plan could be easily modified to adapt it to a foundry which does not have a chemist.

When iron is received at the scale house a notice of its weight is sent to the chemist, who also receives a notice from the supplier giving the grade and the analysis of the iron. These are put down on a 3 x 5-inch card, one of which is shown in Fig. 1. Later check determinations of sulphur and silicon are made. Should these not agree reasonably close with the analysis furnished by the shipper, a second sample is taken. If this sample shows enough variation to warrant asking for a rebate the firm who supplied the iron is notified. Sometimes this firm will allow the rebate without question, at other times it will ask for a part of the sample which shows the discrepancy, or it may send a representative to take another sample in conjunction with the foundry chemist. This check sampling is made possible by the fact that every car of iron is kept separate from all other iron. Sometimes it is stacked on a pile by laborers and at other times it is allowed to lay as thrown off the car, depending whether it is to be used promptly or not. By holding a few cars for emergencies and using the iron as it is received a lot of labor can be saved.

The chemist makes out the charge each day in triplicate on a standard 8 x 10-inch form made up in pads. One of these is sent to the man in charge of getting the stock to the cupola, another goes to the foundry foreman and the third is retained in the laboratory. As can be seen in Fig. 3 this charging sheet tells the foreman of the stock laborers what iron, scrap and coke to put on the charging platform. This man also oversees the charging of the cupola and the charging sheet tells him how many charges to put in and the amount of flux for each charge.

The number of charges is determined by the chemist after he receives a re-

Pig Iron Car No. Pa.167832
From John Jones Co. Rec'd 7/8/19
Grade #3 Weight 103765

	Sil	Sul.	Phos.	Man.
Furnace Analysis	1.64	.040	.617	.63
Check Analysis	1.70	.046		
Remarks				

On Hand 103765		68765		31685	
8-11	2800	8-18	5600	8-25	6300
12	7000	19	6300	26	7000
13	6300	20	6300	27	7000
14	6300	21	7000	28	6300
15	7000	22	6300	29	4700
16	5600	23	5600	30	Out
Used	35000		37100		31300
Left	68765		31685		385

Report of Cupola Consumption—Iron Foundry
For....Week..........Ending....Aug..31.1919..

Grade	Weight Charged Lb.
#2	106300
#3	34700
385 Pounds #3 Added For Car Pa. 167832	
Total Pig Iron	141000
Car Wheels	5300
Cast Iron Scrap	42300
Steel Scrap	6800
Total Metal	195400

Coke 24300 Lb.
Signed
Robert Young Chemist
Date Aug. 18, 1919

FIG. 1—DAILY RECORDS OF INDIVIDUAL CARS OF PIG IRON ARE KEPT ON THE BACK OF CARDS—THE FRONT OF THE CARD SHOWN IN THE UPPER HALF CONTAINS THE ANALYSIS OF THE IRON FIG. 2—WEEKLY REPORTS ARE MADE FROM THE CUPOLA CHARGING SHEET

port, about 10:30 in the morning, from a clerk who ascertains the amount of iron each subforeman will require. Should the general foreman later find that less or more iron is needed he gives the cupola tender instructions without consulting the chemist. The instructions may change the number of charges but not the mixture. Any change in the original program is marked on the charging sheet by the foreman of stock he calculates the amounts of the various grades of pig iron, steel and cast-iron scrap, coke and limestone used, and places the figures on the backs of the proper cards as illustrated in Fig. 1. At the beginning of the week the totals for the previous week are sent to a clerk in the purchasing department on a form shown in Fig. 2. This clerk keeps a record of the amounts of pig iron on hand and the price, by grade The way any discrepancies in weight are checked and corrected may be seen by following the course taken by the car of pig iron recorded on the card illustrated in Fig. 1. The weight of pig iron received is placed on the back of this card, at the top of the first column in the line marked: *On hand.* The first iron from this car was used on Aug. 11, as shown by the date. The fact that only about half the amount was

CUPOLA CHARGING REPORT

Cupola No. **Date** ....191.......

Contract									**Heat Started**		**B.P.**	**oz.**
Grade									**Heat Stopped**		**B.P.**	**oz.**
Car No									**Bottom Dropped**			
Charge	**COKE**	**PIG IRON**						**SPRUES**	**CAST SCRAP**	**STEEL SCRAP**	**CAR WHEELS**	**FLUX**
1												
2												
3												
4												
5												
19												
20												
21												
22												
23												
24												
Totals												

Element	**SIL.**	**SUL.**	**PHOS.**	**MN.**	**T.C.**	**C.C.**	**Transverse**
Computed Comp.							**Tensile**
Analysis of Output							**Shrinkage**

Iron Melted..............................**Lb. per Lb. Coke** **APPROVED**..

FIG. 3—THE CUPOLA CHARGING REPORT IS MADE OUT BY THE CHEMIST—IT INFORMS THE FOUNDRY WHAT IRON TO USE AND SERVES AS A BASIS FOR THE WEEKLY REPORT TO THE PURCHASING DEPARTMENT

laborers and the sheet is returned to the chemist who keeps it on file.

Coke is handled in a similar way, every car load being tested for sulphur and ash. The scrap and sprue delivered to the scrap yard from the foundry, is weighed and the amount reported to the chemist who keeps a record of it on a card similar to the pig iron card, Fig. 1. Foreign scrap is kept on separate cards, each car load having its own card.

When the chemist receives the cupola charging sheet back from the foundry numbers only. He pays no attention to which cars have been used. He also receives a notice of all receipts from the man at the scale house. From these notices he checks the weight for which the company is billed and keeps a record of the amount due on orders. When the purchasing agent decides that it is a good time to order more iron, he consults with the chemist as to the grade to be ordered. However, the time and the amount is finally determined by the purchasing agent according to future requirements and current market conditions. taken that day, as on subsequent full days, would indicate that a new mixture was started about the middle of the heat. The amount used the first week was added in the first column and the amount left, after subtracting the quantity used from the weight received, was placed at the bottom of the first column and at the top of the second. The second and the third week were figured in a similar way, but on Friday of the third week, the iron was reported all used while the record shows that there

(Concluded on page 69)

Conveyors Speed Foundry's Work

Every Half Minute a Mold on Each of Two Conveyors is Cast—A Sand Conveyor Located in the Middle Supplies All the Molders With Sand and Carries the Used Materials Back to the Mixer

BY H. E. DILLER

ECONOMIC laws control business conditions and eventually right every abnormal state in industry. At present an insatiable demand for commodities is met by labor shortage in every activity. These two opposing states rapidly are being reconciled by labor-saving devices which give large production with a minimum of labor Molding machines for many years have been employed in foundries to effect this result and they continually are being improved. Sand handling devices are being used to a greater extent than ever before and help materially in reducing other manual operations. More recently various forms of mold conveyors have found favor as an agency for increasing output and decreasing human effort. All the accumulated wealth of engineering knowledge gained from years of study and the practical adaptation of these different labor-saving methods in foundries making a great variety of castings, light, medium and heavy, is available to the company designing a new foundry. Such a firm is not handicapped by an old building to which conveying machinery must be accommodated at an extra expense for reinforcements and re-arrangements; nor is it limited by the size and contour of a structure already erected. A new enterprise has a clear field to pick the method and the equipment best suited for its work and design the building to house its machinery to the best advantage.

For these reasons a greater number of inducements are held out to the firm building a new foundry, to equip it with a full complement of labor-saving devices. An example of such an installation is found in the new foundry of the Kelsey Wheel Co., Detroit. Until recently this company had no foundry but secured all its castings from outside sources. It has lately erected a foundry building designed to give the best lighting, ventilating and working conditions. This building is equipped with mold and sand conveying systems installed by the Link-Belt Co., Chicago. Two mold conveyors, each having parallel sides connected at the ends with a semicircular section are situated on both sides of a conveyor which carries the used sand to a mixer and back to hoppers suspended over the molding floors. The molding machines are arranged in two rows under the sand hoppers. One of these rows of hoppers may be seen in Fig. 6. The other row is parallel to it on the opposite side of the conveyor. A general idea of the complete system may be obtained from the drawings of the plans and elevations of the sand-handling equipment and one of the conveyors which are shown in Fig. 3. One mold conveyor serves for molds for front and rear hubs for a tractor. A view of one side of this conveyor may be seen in Fig. 9. The molds are placed on the conveyor on the side opposite to the one shown. The small molds are for the front wheel hubs and large molds are for the rear wheel hubs. All molds are poured at the end shown in the foreground

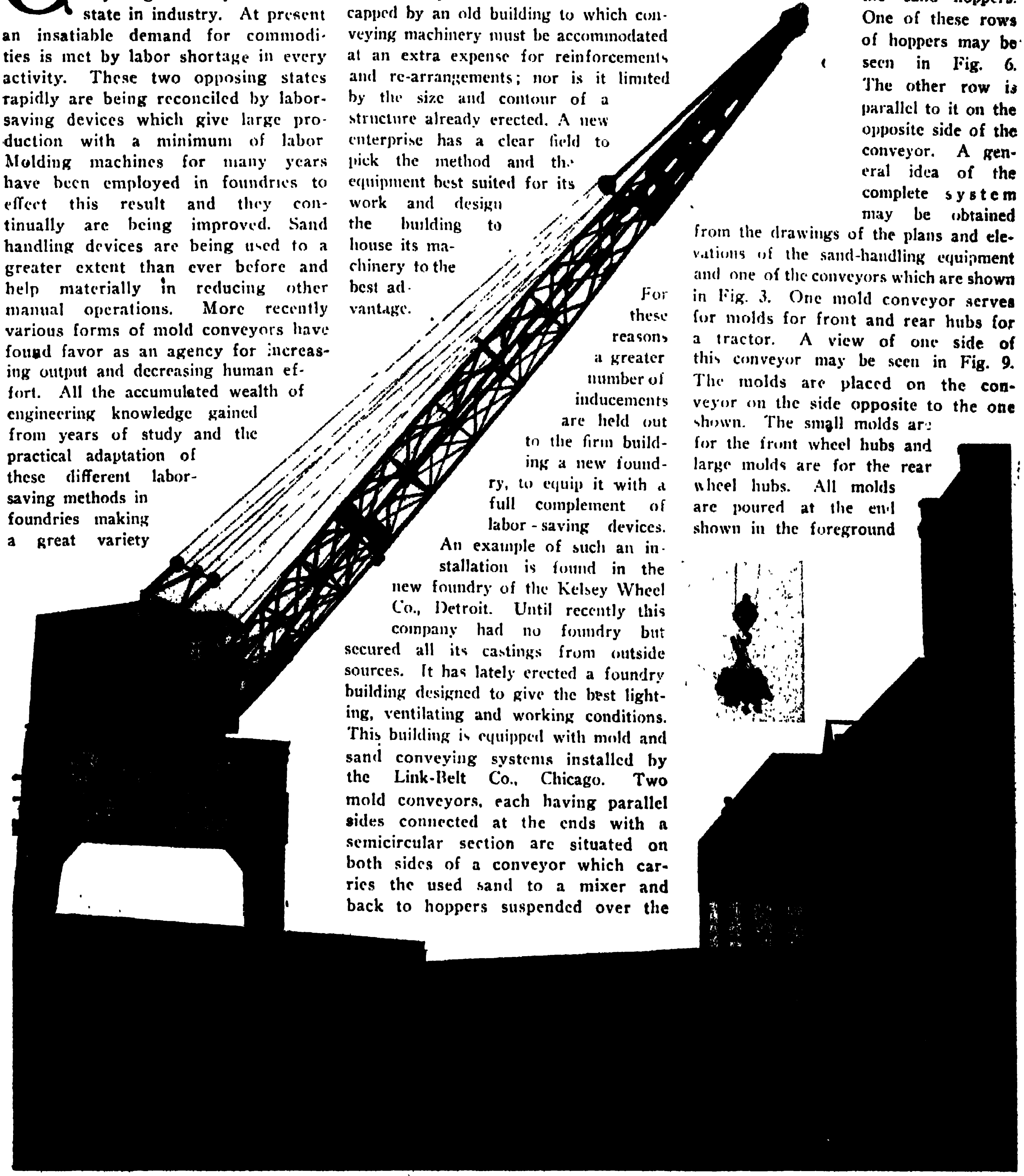


FIG. 1—THIS GANTRY-TYPE JIB CRANE CARRIES PIG IRON, SCRAP AND COKE FROM THE STOCK PILES TO THE CUPOLA CHARGING PLATFORM

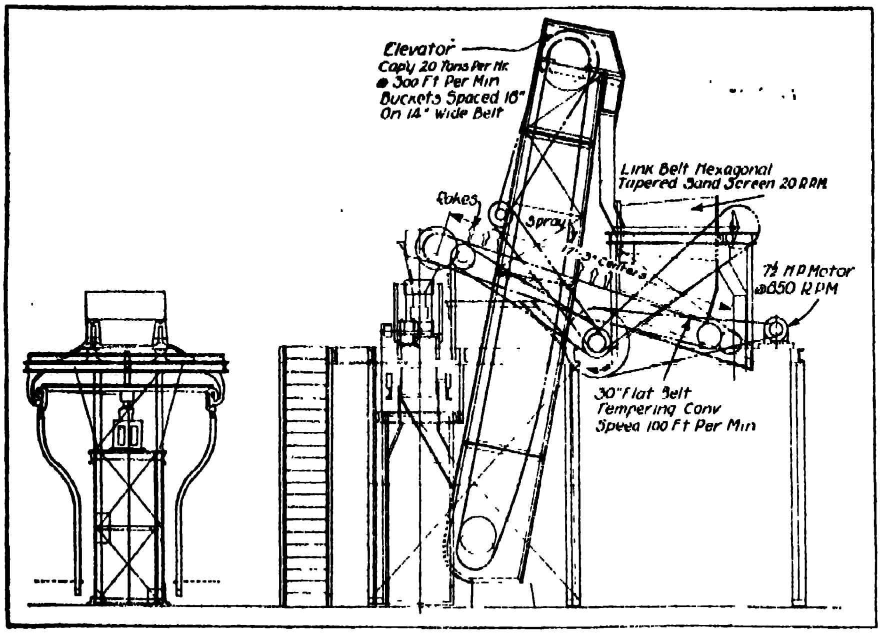


FIG. 2—TO THE LEFT, END ELEVATION OF ONE OF THE MOLD CONVEYORS—TO THE RIGHT, ELEVATION OF THE SAND ELEVATOR, MIXER AND REVIVIFIER

and usually before they reach the point at which pouring is taking place in the illustration. The conveyor has 30 arms made from 3-inch pipe with extra heavy walls. Each arm is fitted with a specially shaped tray for holding the mold, and another flat stand for carrying the cores and the spokes until they are placed in the mold.

The conveyor travels 10 feet per minute and as the arms are 5 feet apart one arm passes any given point every half minute. This means that a mold passes the pouring floor every half minute. There are 30 arms on the conveyor so, at the rate of one every half minute, a complete revolution is made in 15 minutes, or four revolutions are completed every hour. This means that 120 molds are cast in one hour. After the mold is poured at one end of the conveyor it is allowed to cool for approximately seven minutes until it reaches the other end of the conveyor. During this

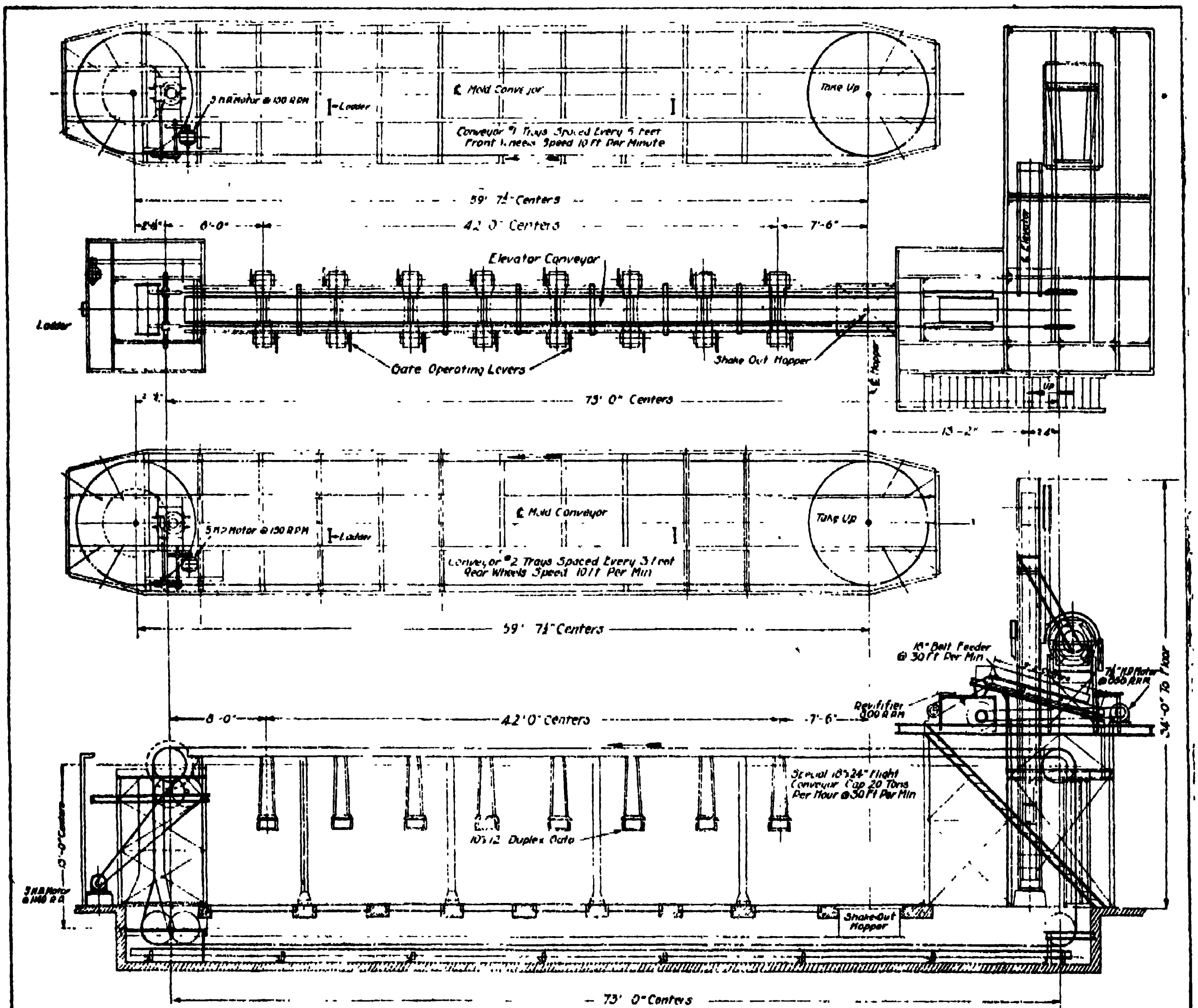


FIG. 3—ABOVE IS THE GENERAL PLAN SHOWING THE SAND CONVEYOR BETWEEN THE TWO MOLD CONVEYORS—THE LOWER VIEW IS A SIDE ELEVATION OF THE SAND CONVEYOR AND MIXING SYSTEM

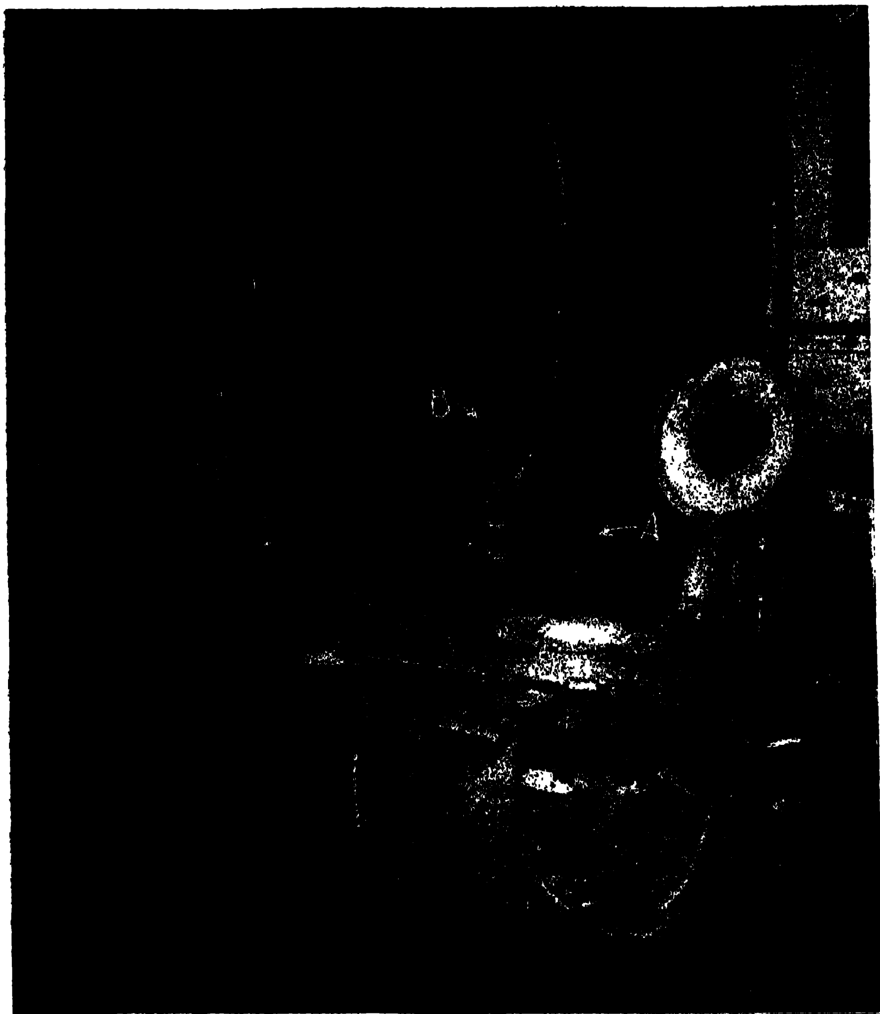


FIG. 4—AFTER THE COPE IS REMOVED CASTINGS ARE LIFTED FROM THE CONVEYOR WITH A GRAB HOOK ON A BLOCK AND TACKLE RIG

time a core is placed on each of the flat auxiliary trays. These cores are carried from the core room upon the stand on which they are baked. The racks are carried on electric trunks furnished by the Baker R & L Co., Cleveland. Spokes also are brought to the foundry floor on electric trucks furnished by the same company. The spokes are strips cut from flat steel bars. A hole is bored through the center of the end which is cast in the hub. This end is also tinned as far as it extends into the hub. The spokes do not thoroughly weld to the iron but are held securely by the iron which fills the hole bored in the spoke ends. The core and spokes in their position on the auxiliary tray may be seen at *A* in Figs. 4 and 5.

The first operation in the production cycle is to make the drags for the front wheel. These are made in duplicate on a squeezer by one molder. The cope for the front wheel also is made in duplicate by one molder. Both the copes and drags for the rear wheel molds are made singly, two molders operating two squeezers being required for each part. The drag is placed on the conveyor by a laborer. Another workman sets the lower line of spokes. The next man sets the core and then the upper layer of spokes are put in place. A laborer sets the cope and the next man closes the mold, filling all joints with molding sand to prevent runouts. The weight connected to the conveyor arm is then lowered and the mold is ready for pouring. As may be seen from Fig. 4, the trays which carry the molds are specially designed to hold the spokes in their proper positions in the mold. One of the weights which has been raised from the mold after casting, also is shown in the same illustration. These weights are solid cast iron and heavy enough to hold down the cope without being clamped. They are hinged to the arm of the carrier and need only be lowered and raised to perform their function.

The molds are poured as they pass the cupola. This operation is shown

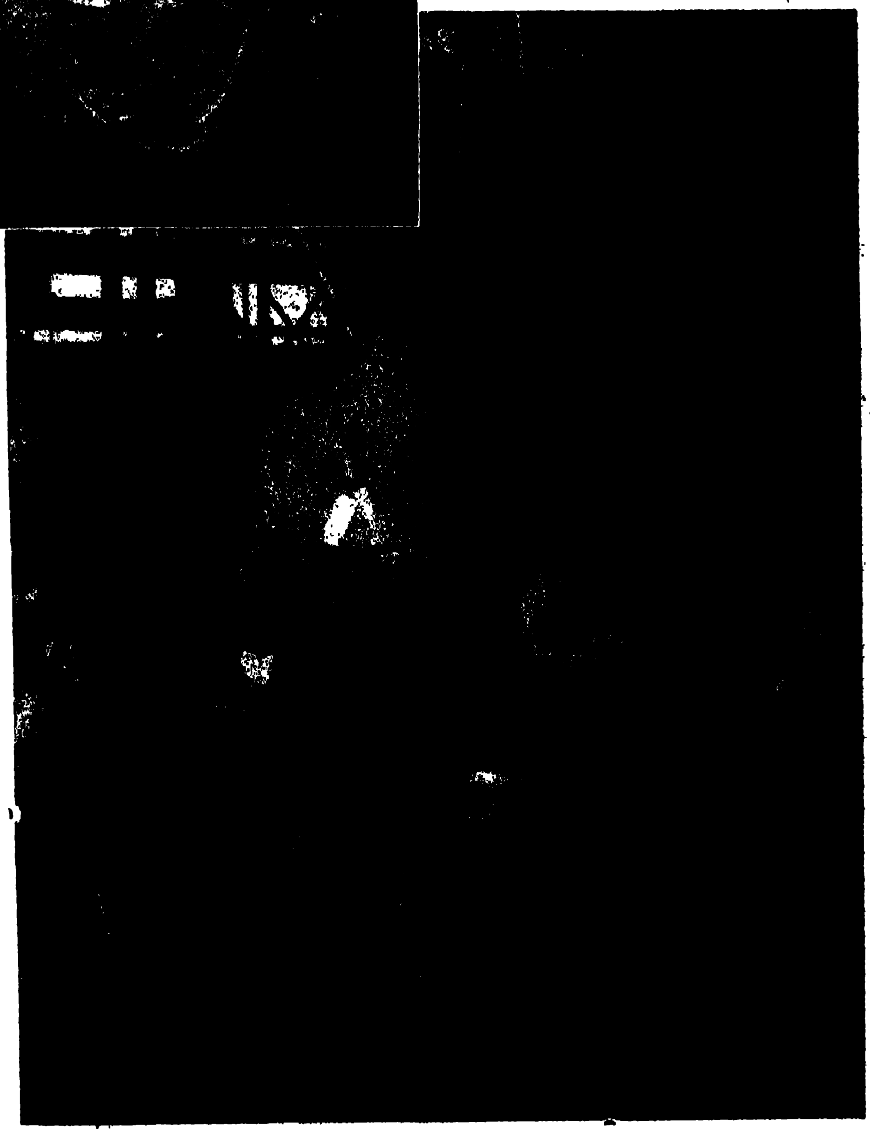


FIG. 5—THE FIRST OPERATION AFTER POURING IS TO LIFT THE WEIGHT OFF THE MOLD

FIG. 6—VIEW OF THE SECOND MOLD CONVEYOR TO THE LEFT WITH THE ROW OF SAND HOPPERS TO THE RIGHT ABOVE THE MOLDING MACHINES—EACH SECOND ARM OF THE MOLD CONVEYOR IS PAINTED WHITE AS AN INDICATION THAT IT IS FOR THE MOLD OF A SPECIAL CASTING—HOISTS FOR CARRYING THE MOLDS FROM THE MACHINES TO THE CONVEYOR ARE SHOWN IN THE CENTER

in Fig. 7. The mixing ladle may be seen directly behind the man standing to the right in the picture.

At present the pouring is done from bull ladles but it is planned to provide a 400-pound ladle on an I-beam trolley for pouring castings. In addition to the men required for pouring, one man is employed at each pouring station skimming the iron as it flows from the ladle. The iron flows into a basin formed by the weight and through a gate into the cope. In the rear-wheel mold this gate is formed by a center core 6 inches in diameter containing six pencil gates. This core also serves to center the print of the main core of the mold which is placed between the drag and the cope. The gate for the front wheel mold is cut in the cope. The metal falls on the print of the center core and is distributed from there through three runners. These two methods of top gating have been adopted because they simplify molding conditions and give satisfactory castings. The hot metal as it runs into the mold forms a pool in the basin made by the weight. This gradually eats away a portion of the weight and makes occasional replacement necessary. For this reason the weights are designed as simply as possible and the expense of replacing them is kept at a minimum. Their life is prolonged by washing them with graphite every night, and filling any cracks in them with graphite paste.

As has been stated approximately seven minutes elapse from the time of pouring until the next operation takes place. When each successive mold reaches the end of the conveyor opposite the pouring station a man standing on a small wooden platform hits the weight with a hammer and then raises it on its hinge and allows it to fall back and rest against the arm of the conveyor as shown in Fig. 5. The mold passes along to the next man who lifts off the cope, shakes out the molding sand upon a conveyor and places the flask back on the conveyor. One of these flasks, all of which are made of cast iron, is seen being carried by the conveyor to the molder at *B* in Fig. 4. While the frames for the front wheel may be placed directly on the conveyor after being lifted from the mold, the frames for the rear wheel molds must first be cooled by plunging into water. This difference is accounted for by the fact that the rear wheel hub is considerably larger than the hub for the front wheel and makes its flask hotter.

The next operation is to lift off the casting. This is done by two men with a snatch block operating on a monorail. The casting is carried over a grating above the conveyor which carries the used molding sand, and any adhering molding sand is knocked off upon the conveyor. The casting then is taken to the cleaning room where the core sand is knocked into another conveyor. After the casting is lifted from the mold conveyor, the drag is taken off and the sand is dumped through the grating upon the sand conveyor. Another workman cleans the sand from the tray and all is ready for another mold to be set in place. The sand conveying systems will be explained more fully later in this article.

At present the completed cleaning system is not installed. When this is in operation the castings will be taken by a conveyor moving continuously through a sandblast cabinet being hung with chains to trolleys on an I-beam. This cabinet will be supplied by the Pangborn Corp., Hagerstown, Md.

The second mold-conveying system is similar in most respects to the one just described. A section of it is shown in Fig. 6. From this illustration it may be noted that the carriers are equipped somewhat differently from those on the first conveyor. These carriers have flat trays and will carry any ordinary mold. The arm of every second carrier is painted white to indicate that it is reserved for a special job. The number of trays and the speed of revolution is just the same as for the first conveyor—30 trays, 5 feet apart, move at the rate of 10 feet per minute, thus making a complete rev-

FIG. 7—THE CENTER CORE OF THE REAR AXLE HOUSING MOLD IS SET WHILE THE CONVEYOR IS IN MOTION

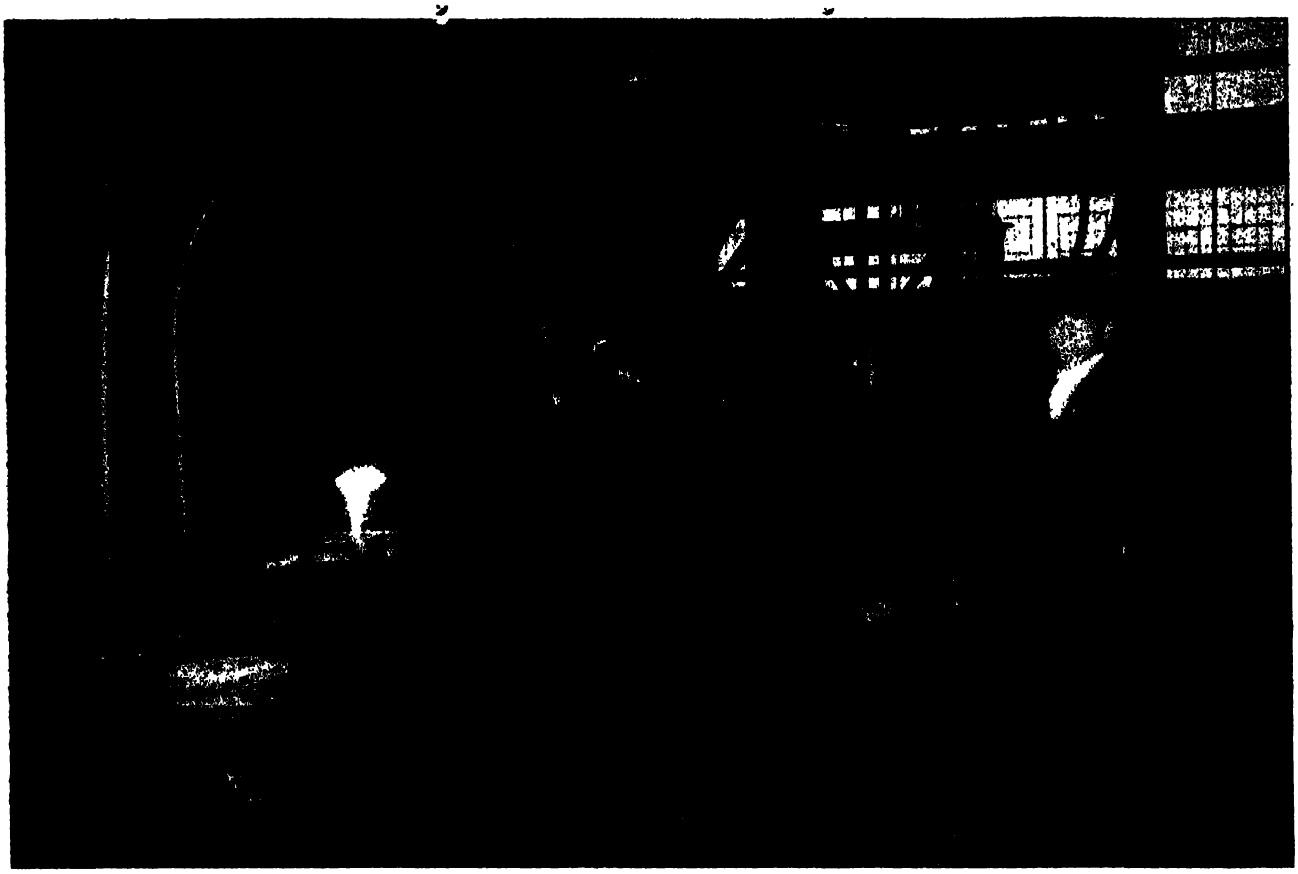


FIG. 8—METAL IS POURED FROM HAND LADLES AT PRESENT—THESE WILL BE DISPLACED BY A 400-POUND LADLE CARRIED ON AN I-BEAM WHICH WILL CONVEY THE QUANTITY REQUIRED FROM THE MIXER WHERE THE CUPOLAS ARE TAPPED TO THE POURING END OF THE CONVEYORS

FIG. 9—THIS CONVEYOR CARRIES THE MOLDS FOR TRACTOR WHEEL HUBS, ONLY ONE CLASS OF MOLDS BEING HANDLED—THE POURING GANG IS SHOWN AT WORK—NOTE THE LIGHTING FROM THE AMPLE GLASS SASH IN THE WALLS

olution every quarter hour in the day.

Fig. 6 shows the details of the second mold conveyor and indicates its relationship to the molding machines and sand conveyor. Looking at the carrier to the front, the two wheels which hold the arm may be seen on the track. Above them is the link-belt which moves the arms. A portion of the wheel around which this belt turns may also be distinguished. The top of the sand conveyor may be seen to the right with the sand hoppers extending down from it. At the upper right-hand corner is shown the steel stairs which lead to the platform on which is located the sand treating machinery.

All jobs which come to the foundry other than the hub castings are cared for on this conveyor. At present a casting for the rear axle housing of an automobile is being made on every second carrier. On the other carriers two different castings are being made. The drag mold for the axle housing is made on two jarram machines supplied by the Cleveland-Osborn Mfg. Co., Cleveland. They are carried from the molding machine to the conveyor by chain hoists running on I-beams one of which is over each of the two machines. These hoists with the I-beams may be seen in the center of Fig. 6. After the mold is placed on the conveyor the center core is set without stopping the conveyor. The core-setter stands on the tray as shown in Fig. 7 to place the core. The print of the core fits into a core gate in the cope. This core has six pencil gates and is similar to the one used for the large hub casting on the first conveyor. The metal flows into this mold over the center core as in the hub castings described.

The mechanical system for handling the molding sand is located between the two mold conveyors. As has been said the molds are shaken out over a grating in the floor. The sand falls through into a hopper underneath, and from here is delivered by a conveyor to the lower run of an elevator conveyor which raises it to the second floor of the building and delivers it to a revolving screen. After passing through the screen the sand is delivered to an inclined tempering belt where the necessary amount of water for tempering is added. This belt delivers the sand to a short inclined belt feeder which in turn delivers the sand to a revivefier.

After the sand passes through the revivefier it falls upon the upper run of the main sand conveyor which carries the sand through the foundry to the molding stations. This conveyor scrapes the sand along a steel trough. At intervals in the trough are rectangular holes which lead into bifurcated hoppers over the molding floors. In this way all the hoppers are kept filled with sand. The lower ends of these hoppers are closed with 12-inch hand-operated gates. Sand carried along the conveyor falls into the first hopper until it is filled. Then excess sand is taken to the next hopper and so on until all hoppers are filled. After all hoppers are filled the excess sand falls through an overflow spout at the extreme end of the conveyor. This directs the falling sand upon the lower run of the main conveyor which carries it back to the elevator and it again goes through the screen. In this way excess sand is kept continually in motion through the system. Gratings are located in the floor the entire length of the lower run of the main conveyor so that castings may be shaken out at any place along the floor.

Core sand is handled is a separate conveying system. It is dumped from the railroad cars into four brick and concrete hoppers. These are under cover and heated to prevent freezing. Each bin has a capacity for 25 carloads of sand. From the bins it is carried by a bucket conveyor to a sand mixer in the core room. This mixer was built by the Standard Sand & Machine Co., Cleveland. The sand is screened after being mixed and then carried to the coremakers' benches by a grab bucket hung on a monorail. Used core sand is reclaimed by passing it through a set of three rolls designed by the Kelsey company. The three rolls are arranged somewhat in the manner followed in steel rolling mills, with the difference that the upper and lower rolls are in the same vertical plane, while the middle roll is offset. Sand is fed between the upper and middle rolls, passes over the middle roll and between the middle and lower roll. The entrance space between the rolls is greater than that between the middle and lower rolls.

The core sand mixture consists of 50 per cent new sand and 50 per cent reclaimed sand. Two different mixtures are used. In the one oil is employed as a binder, and in the other glutrin forms the bond. The oil cores are adapted for the smaller work. A few of the cores are made on benches and the remainder are made on six roll-over machines built by Henry E. Pridmore, Chicago. One of these machines is shown in Fig. 10. In front of the core benches next to the drying ovens are two blackboards. The number of cores made each day of the week are recorded on the board to the left. The number of the principle cores are tabulated in a separate column. The time that a charge is placed in the oven as well as the time each charge is withdrawn is recorded on the board at the right. The coremakers at this bench are making the center core for rear axle housings. One notable feature of the core room is that every coremaker is supplied with an air-hose attachment. Two of these may be noted in both Figs. 10 and 11. To the extreme left of each of these illustrations may be seen portions of the racks on which cores are dried. These racks are carried about the core room on lift trucks supplied by the Barrett-Cravens Co., Chicago, and on electric trucks as described.

FIG. 10—EVERY COREMAKER IS SUPPLIED WITH A LINE OF COMPRESSED AIR—NOTE THE AIR HOSE HELD BY THE COREMAKER, AND IN FRONT OF THE WINDOW ABOVE THE OTHER WORKMAN

The cores are dried in four ovens each of which holds four racks. These ovens which were built by Holcroft & Co., Detroit, are heated by gas secured from the city mains. Each oven is equipped with a recording thermometer supplied by the Taylor Instrument Co., Rochester. The cores are taken from the ovens on the racks by electric trucks and carried to the first floor in an elevator.

A gantry-type jib crane which travels back and forth a distance of about 100 feet carries the pig iron and scrap from the stock yard to an elevated platform immediately outside of the cupola charging floor. Although this crane does not travel a great distance its long boom, raising and lowering, and revolving in a circle, enables it to cover a large area of ground. Frequently pig iron is taken from the car in which it was received and delivered direct to the charging platform by the crane. At other times the pig iron is unloaded on the stock pile and later delivered from there to the charging platform. While the pig iron is handled by a magnet, coke is taken to the charging platform by the crane in a grab bucket, shown in the foreground of the illustration.

Two cupolas made by the Whiting Foundry Equipment Co., Harvey, Ill., have been installed. One of these cupolas is lined to 42 inches diameter and the other to 54 inches. The smaller cupola at present is in use almost exclusively. The charge in this cupola consists of 400 pounds of scrap iron, 600 pounds of No. 2 pig iron and 10 or 20 pounds of ferrosilicon. The latter contains approximately 8 per cent silicon. Between the charges of metal, 160 pounds of coke are used. Scrap iron from the cast of the previous day is put in the first charges with 10 pounds of ferrosilicon. After this is all used, foreign scrap is substituted and the amount of ferrosilicon is increased from 10 to 20 pounds. A record of the amounts charged is kept on a large blackboard hung on the wall of the charging room, so that any person coming into the room at once may see what has been done. Iron from the cupola is caught in a 3000-pound reservoir ladle in order that it may become better mixed before it is poured into the casting ladle.

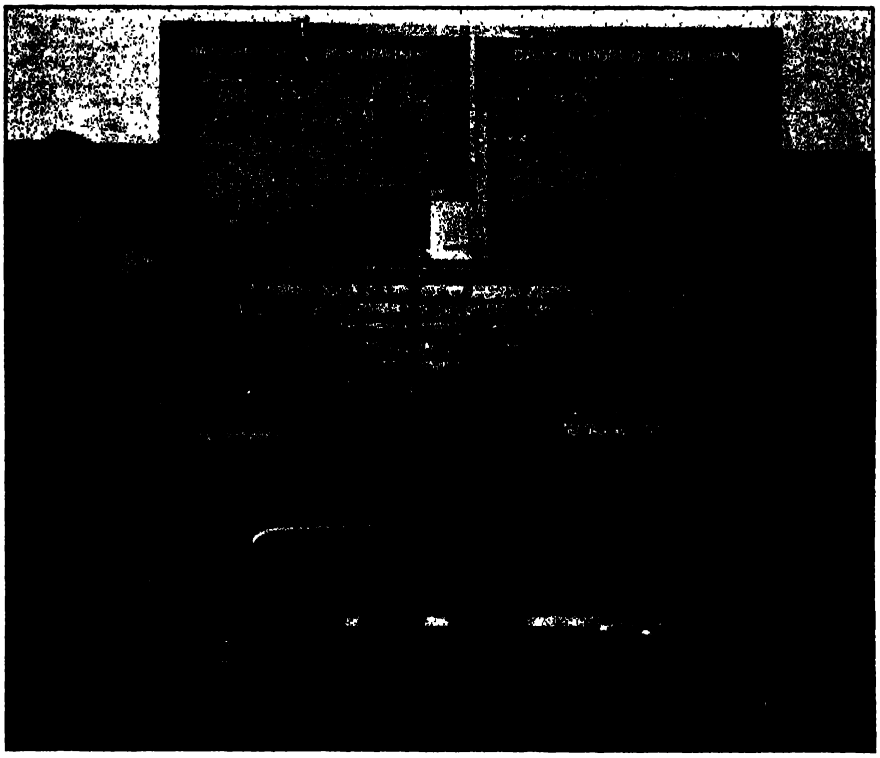


FIG. 11—A RECORD OF THE NUMBER OF CORES MADE AND THE TIME THE CORE OVENS ARE CLOSED AND OPENED IS KEPT ON TWO BLACKBOARDS

Scientific Mixing

The chemist has entire charge of mixing and melting the iron and is responsible for its quality. To determine whether the iron is satisfactory a number of intermittent tests are made. The amounts of silicon and sulphur in the iron are found by chemical analysis three times a day. Brinell tests are made frequently to ascertain the hardness of the iron. Transverse tests are made on a 1-inch square bar. This size bar has been found to give the most concordant results.

Temperature is a most important consideration in casting the metal and heat tests are made frequently by noting the length of time required for the pool of iron in the pouring basin of certain castings to set. Pouring is continued through the entire day about 25 tons being melted during the working period. Blast is turned on at 7:50 a. m. and about 8:15 iron is tapped. The air is shut off 15 minutes for lunch and finally for the day shortly after 4 o'clock. The dump from the cupola is cleaned in a water mill built by the W. W Sly Mfg. Co., Cleveland.

The building has a roof with two monitors. The sides are glass sash from the sill to the roof. These sash were furnished by the David Lupton's Sons Co., Philadelphia. This type of construction has the disadvantage of requiring a large amount of heat to keep the plant interior warm, but it has the great advantage of giving plenty of light in the shop. Fig. 9 illustrates the clear illumination furnished by the wall of glass.

Acids For Pickling

Question—Please advise us the best known method of pickling cast iron.

Answer—The best method to use will depend upon the condition of the castings before cleaning and the purposes for which they are intended. In one method of pickling the castings are placed in a bath of hydrofluoric acid diluted with eight times its bulk of water. The castings may be allowed to remain in the bath any length of time after the sand is all eaten away as the acid does not attack the metal. After the castings are removed from the pickling solution they should be washed thoroughly in clean hot water. One disadvantage of this method of pickling is that the oxide scale is not cleaned from the casting, but there would be little such scale on iron castings and it would not be objectionable on castings for some purposes.

Other methods for pickling require a pickle of hydrochloric acid diluted with three times its bulk of water, or a pickle of sulphuric acid diluted with five times its bulk of water. It is necessary to remove the castings from these solutions as soon as they are cleaned and wash them in hot water, otherwise the acid would continue to eat the iron and cause an undue waste of acid and metal. Castings are sometimes cleaned with hydrofluoric acid to remove the sand and afterwards put in a pickle of either hydrochloric acid or sulphuric acid to remove iron oxide scale.

Training Men For Foundry Duties

Existing Conditions in Foundry Labor Demand a More General Use of Short Time Training Systems for the Apprentice Labor and Unskilled Help Now Available

BY C. C. SCHOEN

DURING the stress of war, the training and dilution service of the United States department of labor discovered that many helpful features of organized training as applied to the production of war materials were equally applicable to peacetime industry. Therefore, immediately after the signing of the armistice this service was reorganized under the name of the United States training service to assist all industries, desiring assistance, to establish methods of training their workers within their shops. Among the industries that requested assistance of this service were machine, tool, textile, shoe, rubber, foundry and others.

With the number of available training experts limited, and a due date of June 30 set for the completion of this work, C. T. Clayton, director of the service, realized that only a fraction of those factories seeking help could be accommodated, and therefore delegated to different committees the task of outlining recommendations applicable to the particular industries most urgently requiring and desiring assistance.

The committee on foundry training confined its activities to the following schedule:

1. Confer with foundry organizations, clubs, owners and managers throughout the country, to ascertain their attitude and opinion.
2. Determine by means of a questionnaire—
   (a) Character and extent of training being carried on at present.
   (b) Reasons for present lack of training.
   (c) Extent to which training is desired.
3. Outline recommendations for the guidance of those instituting foundry training covering apprenticeship training, upgrading and training foremen.

The foundry organizations conferred with were not only interested and enthusiastic, but appointed committees to co-operate. Aside from a small minority (less than 1 per cent) the owners and managers were enthusiastic and pledged their support. About 1 per cent of the 646 foundries investigated have a definite program and less than 1 per cent give technical instruction. Of the 440 foundries replying on the upgrading question, 65 per cent are active in upgrading their help. The chart shown as Fig. 1 illustrates the extent to which training is carried on at present in foundries located in different parts of the country.

Considering the high turn-over prevalent in foundry apprenticeship, which in some cases has been given as high as 150 per cent, it is evident that the number completing their apprenticeship is very small. In general, the following reasons were given for the present lack of apprenticeship training:

Reluctance of young men to engage in foundry work.

Ease with which many young men with limited experience and knowledge can secure employment as journeymen.

The tendency of foundry employes to discourage apprentices.

Inability of foundry owners to master their training problems, etc.

Causes of the reluctance of young men to engage in foundry work have been given as low wages, unsanitary conditions, laborious work, monotonous routine, adverse influence of public schools, the four year apprenticeship clause, lack of any sound, practical, or definite training program, and lack of proper incentives.

The effect of these causes on foundry apprenticeship, as illustrated by the chart, is the low percentage of apprentices entering this work and the result that few of those who enter complete their apprenticeship.

In order to solve the wage problem, a few foundries make a practice of studying the cost of living in their town and granting apprentices' cost of living plus a percentage, ranging from 10 to 70 per cent. The highest percentage is paid to apprentices in their last year of apprenticeship.

A handicap, which many foundries have applied to their apprenticeship systems, is "inertia of habit." Systems with the indentured agreements and rates of pay instituted 15 years ago, are still in use, although perhaps not operating.

Working toward the elimination of the effect of low wages, the four-year apprenticeship clause, the institution of proper incentives, etc., a plan is being developed whereby an apprentice's work, length of indentured period and compensation is dependent upon merit and accomplishment rather than time. This involves placing all apprentices on a two months' trial, and those accepted at the end of every six-month period are graded into classes as follows:

Class A, apprentices serving 825 hours per period.

Class B, apprentices serving 962 hours per period.

Class C, apprentices serving 1100 hours per period.

The compensation is as follows:

Periods of entire course	1	2	3	4	5	6	7	8
Per cent of journeyman's pay ..	33	36	39	43	47	52	58	66

To overcome the laborious and unsanitary conditions existing in many foundries, the adoption of sanitary, safety and labor-saving regulations as recommended by the American Foundrymen's association and others is recommended. The following quotation from a letter received is indicative of what is being accomplished in this direction.

"* * * We are trying to gradually induce men to become foundry employes and to place the entire foundry on a higher plane, as we find that the average workman seems to feel that the foundry is hard work indeed and disagreeable place to work. To offset this, we have built what we believe to be the lightest, cleanest and best ventilated foundry in the United States; have installed lockers for the men's clothes, shower baths, drinking fountains, ample ventilation for summer and ample heating in the winter; which makes the foundry a comfortable and desirable place in which to work."

To eliminate the condition of monotony, and to work toward a sound, practical and definite training program, the committee recommends a more general routing of apprentices into the different branches of foundry work and co-ordinating this practical experience with definite, practical technical instruction.

The machine and tool industry in a few cities has sought to acquaint the public school authorities with the

From a paper presented at the Philadelphia convention of the American Foundrymen's association. The author, C. C. Schoen, was with the United States department of labor, training service, Stamford, Conn.

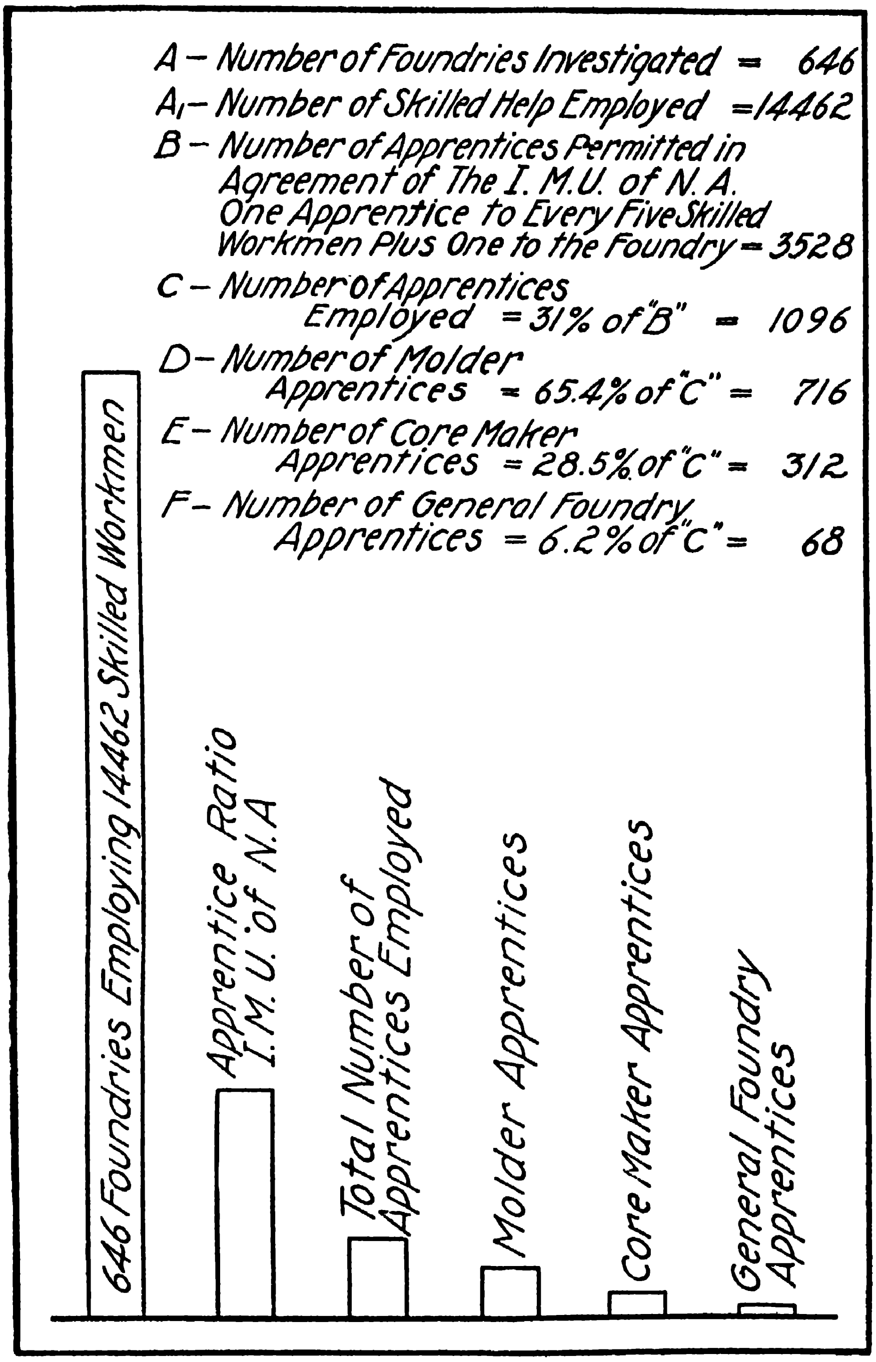


FIG. 1—CHART SHOWING RELATION OF NUMBER OF APPRENTICES TO TOTAL EMPLOYED AND TO TOTAL NUMBER POSSIBLE

importance of its trade by delegating a competent mechanic or engineer to lecture before the teachers' association on the character and importance of its work, and the opportunities existing for development. I am quite certain that a half-hour talk by a competent foundryman to a group of public school representatives would arouse in them a deep interest and respect for the foundrymen's trade.

The ease with which many young men, with limited knowledge and experience, can secure employment as journeymen is a direct result of lack of training. We have established a low standard in the foundry and apprentices apparently find a short term sufficient to measure up to the standard set.

The tendency of foundry employes to discourage apprentices must be overcome through education. Many employes sincerely and honestly discourage apprentices because they labor under unsanitary and unsafe conditions. There are other employes, however, who discourage apprentices because of selfish motives. Cases have been brought to light where journeymen and foremen advised apprentices that a study of technical subjects was nonessential and at the same time they secured for their private study copies of lessons given apprentices.

The inability of foundry owners to master their training problems is chiefly due to lack of knowledge of the subject and the fact that they too often delegate this work to an overburdened foreman or a person incompetent to effectively operate the plan.

A clear conception of the purpose in view, an understanding of the methods and kind of authority necessary to achieve this purpose, ability to secure co-operation, centralization of training responsibility, a definite training program, practical instruction, workable standards, accurate records, and a square deal, are essential to success.

Existing conditions in the foundry industry necessitate a more general use of the upgrading system, which involves an intensive short-time training of the present labor and semiskilled help.

In order to meet this condition and at the same time pave the way for a broad training, the branches of training have been divided into units as

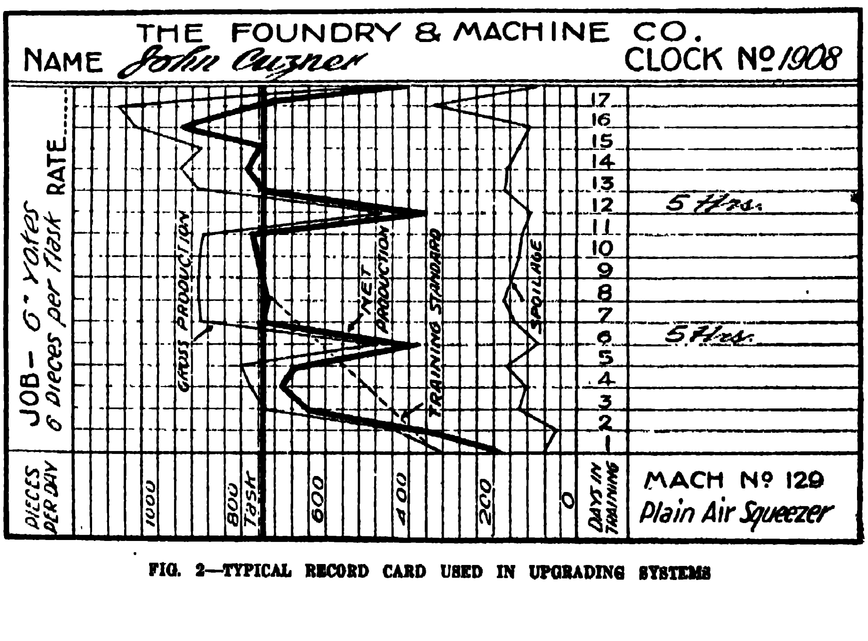


FIG. 2—TYPICAL RECORD CARD USED IN UPGRADING SYSTEMS

Branches of Training For Upgrading Foundry Students

Worker in Cleaning Department

Materials—Sand, abrasives, gases, acids, misc.
Equipment—Scratch brushes, chisels, hammers, files, etc.
Operations—Cleaning, finishing, assorting, repairing, mixing, applying.

Assistant to Melter

Materials—Pig, scrap, flux, fuels, refractories.
Equipment—Shop and its construction.
Operations—Charging, firing, drawing, repairing.

Pouring

Materials—Sands, clays, blackenings, misc.
Equipment—Shop and its construction.
Operations—Lining, baking, pouring, care of ladles.

Coremaking

Materials—Sands, binders re-enforcements, fuels.
Equipment—Shop and its construction, coremakers'.
Operations—Mixing sands, ramming, venting, re-enforcing, baking.

Machine Molding

Materials—Sands, facings, partings, patterns, misc.
Equipment—Machines and their construction.
Operations—Tempering sands, ramming, re-enforcing, venting, finishing, setting cores, securing, pouring.

Bench Molding

Materials—Sands, facings, partings, patterns, misc.
Equipment—Shop and its construction, molders'.
Operations—Tempering sands, ramming, re-enforcing, venting, finishing, setting cores, securing, pouring.

Side Floor Molding

Materials—Sands, facings, partings, patterns, misc.
Equipment—Shop and its construction, molders'.
Operations—Tempering sands, ramming, re-enforcing, venting, finishing, setting cores, securing, pouring.

Crane Floor Molding

Materials—Sands, facings, partings, patterns, misc.
Equipment—Shop and its construction, molders'.
Operations—Tempering sands, ramming, re-enforcing, venting, finishing, setting cores, securing, pouring.

Loam Molding

Materials—Sands, facings, partings, patterns, bricks, misc.
Equipment—Shop and its construction, rigging, molders'.
Operations—Laying bricks, sweeping, finishing, baking, assembling, securing, pouring basins.

Assembling

Materials—Sands, facings, chaplets, misc.
Equipment—Shop, assemblers'.
Operations—Lifting, setting cores, securing, pouring basins.

Heat Treating and Annealing

Materials—Refractories, fuels, misc.
Equipment—Location, construction.
Operations—Charging, heating, drawing, repairing.

shown in the accompanying table to permit those desiring a broad training to gain experience and knowledge.

In instituting an upgrading system, consideration should be given to—

Centralization of training responsibility.
Definite training policy.
Location of training activities.
Competent instructor.
A detail study and analysis of each job in order to establish a standard time and a best method.
Issuance of standard practice instruction.
Record form, including standards of quality and quantity.
Follow-up system.

The record card, shown in Fig. 2, is representative of a type being developed at present.

In conclusion, the writer suggests that a definite stand be taken in regard to the following:

Extent to which apprenticeship training is essential.
A standard of merit and accomplishment toward which training should be directed.
A standard form of indentured period.
Branches of training.
Length of indentured period.
Character of instruction.
Securing co-operation of public schools and assistance through the Smith-Hughes act.
Hours and time of instruction.
A standard record form.
Compensation.
Incentive.
Reward to graduates.
The establishment of a central clearing house to gather, develop and distribute literature and information tending to develop knowledge and higher intelligence in foundry work.

The last suggestion has been submitted by Dr. Richard Moldenke, Pat Dwyer, and others. Mr. Dwyer has submitted a suggestion in writing as follows:

"Instead of trying to get a competent local instructor for each plant, a feat which is neither practicable or possible, a central bureau should be established. A series of condensed papers could be prepared on every phase of standard foundry practice, each one by an acknowledged practical expert in his line. Copies of these papers would then be available for any man anywhere who wished to take advantage of them. The merits of this plan are that only the best methods would be in circulation; only those who are really in earnest would take advantage of them; and by having a competent representative body to sponsor and finance the scheme, the cost would not be excessive in any particular case."

In the final analysis, the success or failure of this work will depend upon the extent to which foundries will institute and promote training in in their own shops. The problem should be handled in each locality, individually.

There is a strong tendency among foundrymen to let the other fellow do the training and a few foundries have stated that they are not bothering with apprentices because they employ only first-class molders and prefer to hire these finished mechanics as best they can.

If every foundryman will appreciate the fact that his experience and trained men will do most toward the progress of the foundry and then honestly and wisely endeavor to promote such training as is best applicable to his particular foundry, a start will be made, the results of which may far surpass expectations.

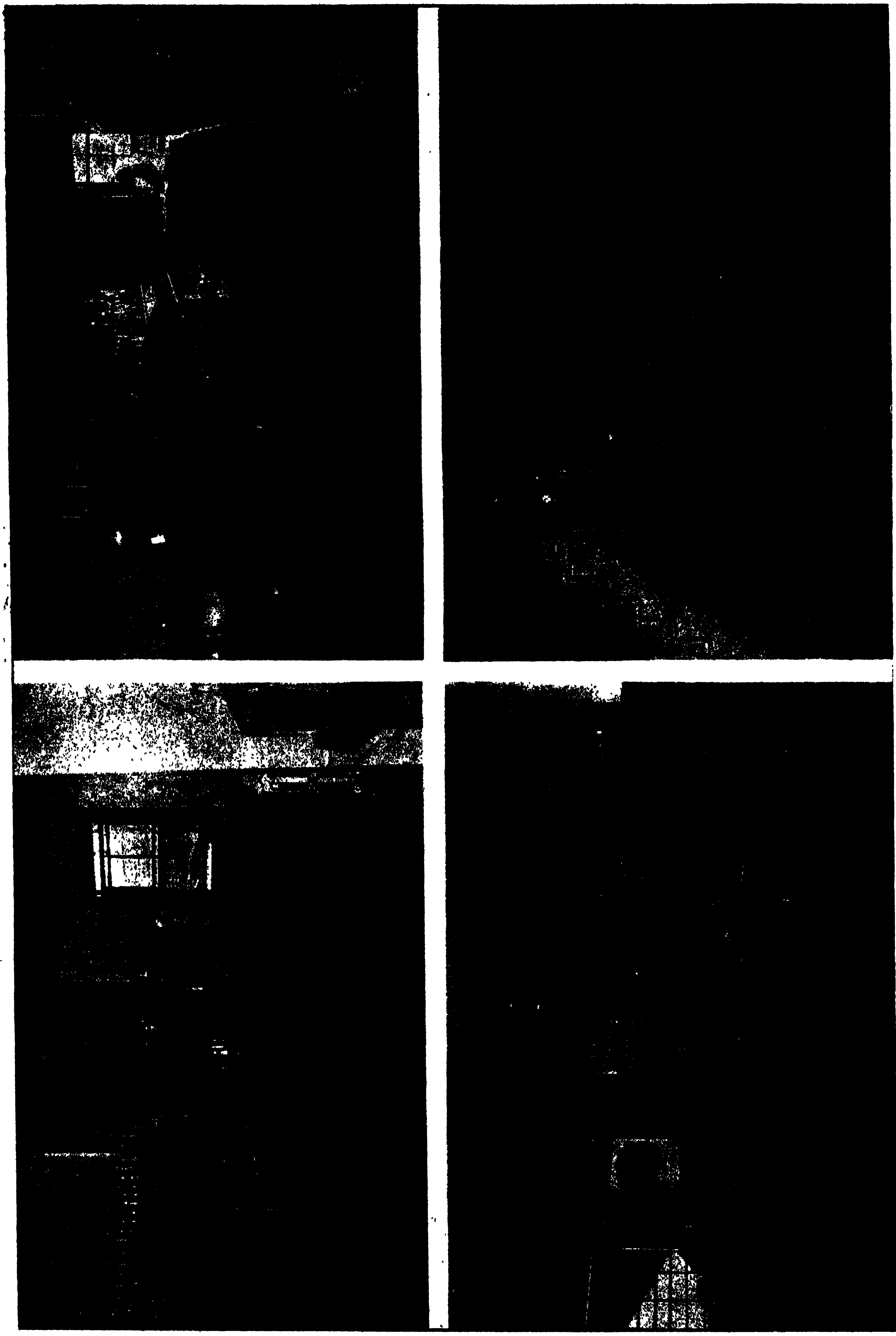
Organizes New Foundry

The Vassar Foundry Co. has been organized by J. C. Green and M. B. Giterson for the manufacture of light gray iron castings in Vassar, Mich. The company is capitalized at $40,000. Ground has been broken for the first of four units, each one of which will be 60 x 160 feet. It is expected that the first unit, employing 50 men will be in operation by Feb. 1 and the others will be finished and placed in operation during the year. J. C. Green, the president of the new company, also is president of the Modern Pattern & Machine Co., Central Pattern Works, Newlin Coreoil Co., and the Gratiot Welding Co., all of Detroit; and the Pattern & Castings Co., Saginaw, Mich. M. B. Giterson is manager of the new company.

Completes New Factory

The Lindsay Chaplet & Mfg. Co., Harrison building, Philadelphia, practically has completed a factory covering an area of approximately 19,000 feet at Marcus Hook, Pa., to be used exclusively in the manufacture of foundry chaplets and light metal specialties and employing about 50 workmen. The main building and extensions were constructed by W. W. Lindsay & Co., Inc., Philadelphia.

A core mixture recently patented by J. P. Elliott is formed by mixing pulverized asphalt with the core sand. As the asphalt lacks binding properties before it is melted, the inventor also adds flour to the sand to give it plasticity. The cores are baked until the asphalt melts.



FIGS. 1-4—VIEWS OF THE LABORATORY OF MARION STEAM SHOVEL CO., WHERE STEEL IS ANALYZED AND TEST BARS TESTED FOR PHYSICAL PROPERTIES

Making Manganese Steel by the Open-Hearth Process

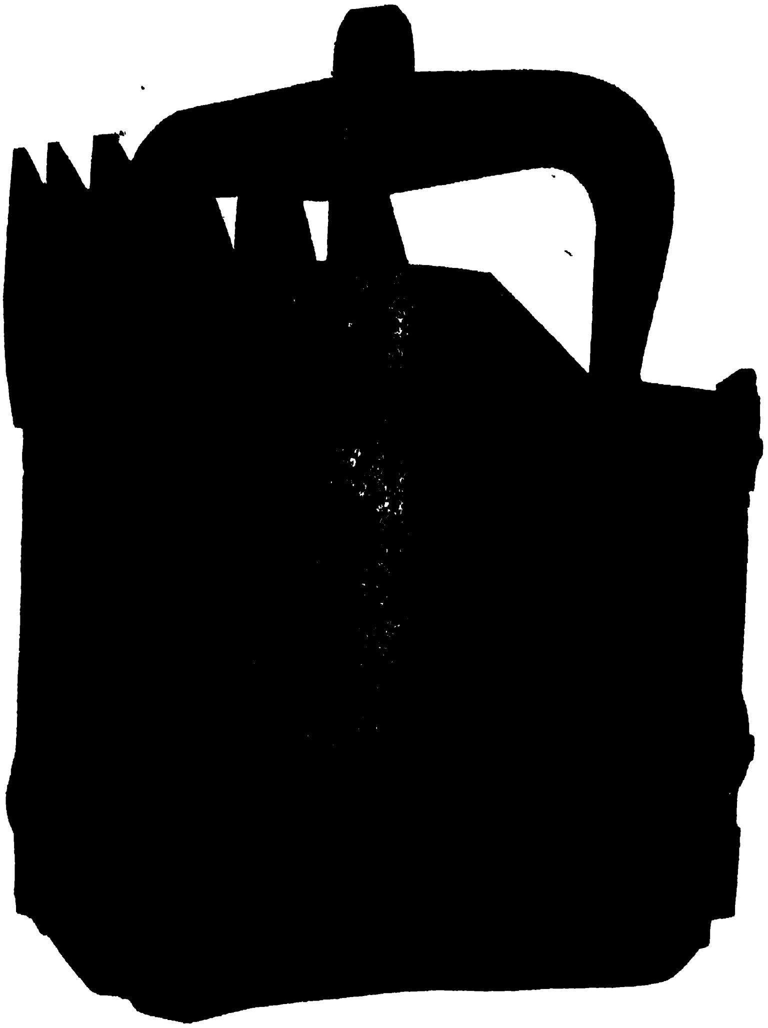


Fig 5 Modern steam shovel dipper The dipper front and teeth are of manganese steel

Steel Containing 12 Per Cent Manganese is Made by Open Hearth Instead of Bessemer Process Usually Employed—Method of Adding Alloy and Quenching Heat Treated Castings Unique

BY E. L. SHANER

STEEL always has been an important factor in the development of equipment employed to perform the arduous tasks formerly accomplished by manual labor. This is especially true of steam shovels and dredging machinery, which have undergone a steady and rapid development since 1834 when the first power shovel was built at Springfield, Mass. The most notable improvements have taken place during the past decade when the demand for machines of large capacity and great power caused designing engineers to seek material especially adapted to the great variety of requirements imposed on the different parts of the machines. For instance, in certain castings used in the construction of power shovels, ability to withstand the abrasive action caused by contact with stone, sand, slag and similar substances is essential. It is particularly important that dipper fronts and teeth possess this property. By constant study of the requirements for steel working in contact with steel, engineers have taken cognizance of the fact that pinions are subjected to far greater wear than the gears with which they mesh. To equalize this difference, the pinions have been made of steel having greater resistance to wear than the steel of the gears. This is only one instance of many in which special specific demands have been made of the materials entering into the construction of excavation machinery.

Manganese is known to impart unusual toughness to steel and for this reason manganese steel is generally employed in parts subjected to excessive wear. The common practice at present followed by manufacturers of manganese steel for this purpose calls for a manganese content of from 11 to 14 per cent.

When manganese steel was first made in the United States, steelmakers employed the acid bessemer process for melting the steel and added the required amount of manganese as the metal was being tapped. Either this practice with slight modifications, or the electric furnace process now is followed in practically all manganese steel works in this country with but few exceptions. One of the makers of manganese steel employing the open-hearth furnace is the Marion Steam Shovel Co., Marion, O. In common with other firms, the Marion company first employed converter steel as the basis of its manganese product, but several years ago open-hearth metal was adopted for this purpose and has been used with unusual success.

The company's preference for open-hearth metal is based upon the belief that with this process it is easier to maintain the phosphorus content at the low percentage desired. Moreover, the authorities at this plant are convinced that not nearly as many impurities are carried into the metal poured from open-hearth steel as in that in which converter steel is the base. As is well known, bessemer steel requires more deoxidation than open-hearth steel, and it is pointed out, therefore, that the addition of manganese to open-hearth metal, in which the real need of a deoxidizing agent is less than in the case of converter steel, leaves the resulting product unusually free from impurities.

At Marion the making of manganese steel is carried on in the steel foundry where castings ranging in weight from one pound to 16 tons

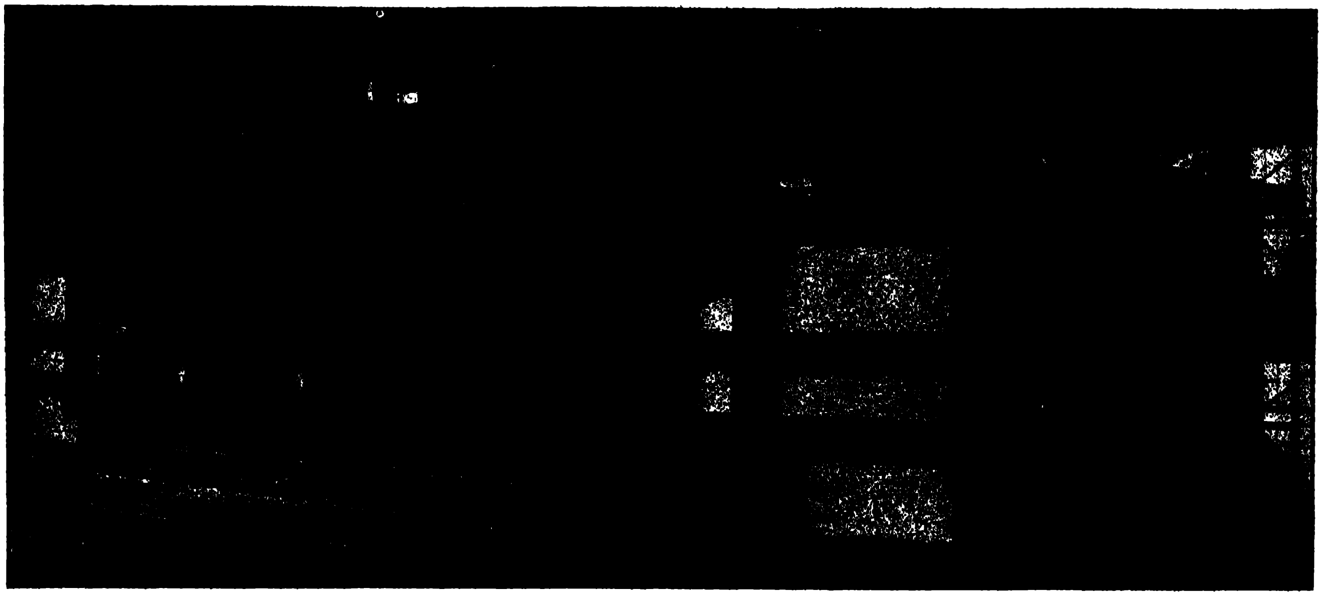


FIG. 6 VIEW OF A 20-TON OPEN-HEARTH FURNACE FROM CHARGING SIDE

are made. The tonnage of manganese steel averages approximately 5 per cent of the total output of the foundry. In October, a month somewhat below the average in production, 63,636 pounds of manganese metal was poured.

Description of Foundry

The melting equipment consists of a 20-ton, nontilting, basic open-hearth furnace and a small oil furnace for ferromanganese. The open hearth is at the south end of the east bay of the steel foundry and is served by a floor-type charging machine made by the Wellman-Seaver-Morgan Co., Cleveland. The molding floors extend the entire length of the main bay and northward from the charging platform in the east bay. The main bay is commanded by one 30-ton and two 10-ton electric traveling cranes and the side bay by two 10-ton cranes. The cores, which are made in a core shop situated in the east bay, are baked in a coke-fired oven adjoining the east wall of the building. Molds are dried in a car-type, oil-fired oven outside of the foundry building. Provision has been made for moving oven cars by means of steel cables operated by power-driven drums.

A novel arrangement has been adopted for handling the molten metal preparatory to pouring. When it is desired to make a heat of manganese steel, the furnace operator is given instructions to make steel of the required analysis. In the meantime, the necessary amount of 80 per cent ferromanganese is charged into the small furnace.

FIG. 7—REPRODUCTION OF PHOTOGRAPH TAKEN AT NIGHT OF CASTINGS ON CAR JUST REMOVED FROM HEAT TREATING OVEN AND ABOUT TO BE THROWN INTO QUENCHING TANK

A large ladle is placed on the platform of floor scales directly under the spout of the small furnace, and the balance weights are set for the amount of manganese required, proper allowance being made for the weight of the ladle. In predetermining the exact amount of metal to be tapped, the condition and quantity of slag is taken into consideration. After the manganese has been tapped into the ladle, the balance weights are adjusted for the addition of open-hearth metal, which is bottom-poured from a large crane ladle. The rush of molten steel into the bottom of the mixing ladle has a stirring effect upon the contents and thoroughly distributes the manganese.

Process Modified if Desired

Another method of mixing which has been used successfully consists of pouring a quantity of open-hearth steel into the mixing ladle, adding the manganese, and then the remainder of the open-hearth metal. With either of the methods described it is possible to produce metal conforming to the following specifications: Carbon, 1.10 to 1.30 per cent; phosphorus, 0.055 per cent (maximum); sulphur, 0.04 per cent (maximum); and manganese 11 to 14 per cent. Steel of this analysis is used for dipper fronts, teeth, rack and pinion castings, elevator dredge buckets, latch plates, wearing plates, propelling gears, pinions, etc.

Just prior to pouring, the metal is thoroughly teemed to insure soundness. In distributing the molten steel to the molds, it is bottom poured from the ladle in which the open-hearth steel and manganese were tapped at the furnaces. As a rule the metal is handled in 6-ton ladles, it being possible to fill two ladles of this size from each heat of the open hearth. The capacity of the furnace is three heats per day.

After the molds are shaken out the castings are ready to be cleaned in a building south of the steel foundry which is entirely devoted to this work, after which they are subjected to the usual heat treatment for manganese steel. This consists of heating the castings to a temperature of about

1800 degrees for approximately 8 to 20 hours depending on the size and shape of castings, followed by quenching in water. The equipment for heating and quenching is decidedly novel.

The cleaned castings are placed on oven cars, the front doors of the ovens resting on one end of the cars. Each of the two ovens is about 6 feet wide by 14 feet long and is hand fired with coal. The temperature of each is registered by electric pyrometer recorders in the office of the company metallurgist. When the castings are ready to be taken from one of the ovens, a steel cable is hooked to the car and it is slowly drawn out by means of a power drum.

As the car is drawn from the furnace it runs on a track pivoted longitudinally over the quenching tank shown in Fig. 9. As the car nears its position on the tilting portion of the track a workman throws a lever which raises two hook-shaped castings to a vertical position, where they engage the axles of the car, which is held tight against the hooks by the tension of the cable. The car being securely clamped to the track, air is admitted to an air cylinder underneath, the rising piston of which tilts the track to an angle of about 45 degrees, where further tilting is prevented by wooden stops. The rapid tilting of track and car causes the castings to slide off into the quenching tank, which is filled with water. The castings are recovered by means of a traveling crane which spans the tank and is operated from a nearby control station.

In order to keep a close check on the chemical composition of the steel, the metal of each ladle is completely analyzed in the well-equipped laboratory maintained by the Marion company. Test bars are taken from each ladle tapped from each heat, and carry the date and heat number for identification. Each test bar remains with the castings throughout the heat treating process, after which it is tested for physical properties. In case a defect is revealed by the testing of a bar, all of the castings poured from the heat are again heat treated. Another test for physical properties is

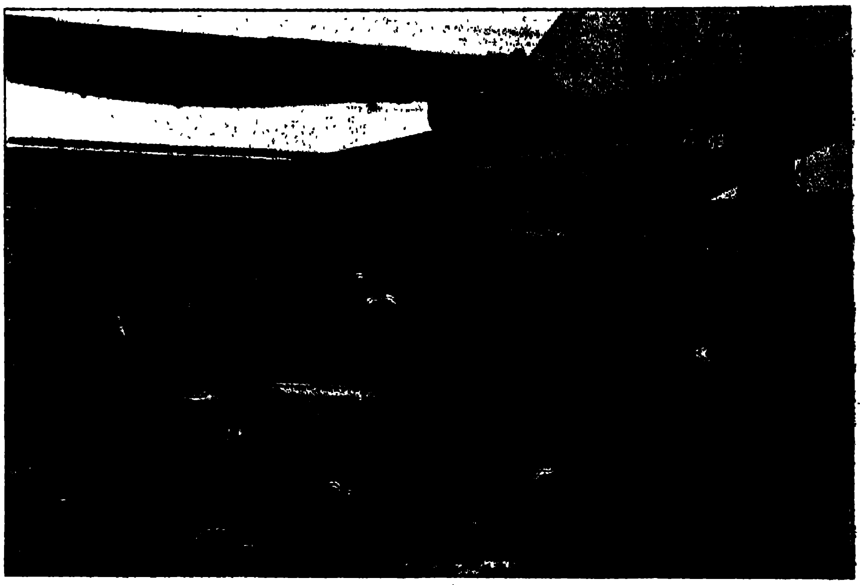


FIG. 9—OVEN CAR ON PIVOTED TRACK DIRECTLY OVER THE QUENCHING TANK—AFTER CAR IS ANCHORED TO TRACK BY HOOK OVER AXLES, TRACK AND CAR ARE TILTED TO ANGLE OF 45 DEGREES WHICH IS SUFFICIENT TO HURL ALL CASTINGS INTO BATH SIMULTANEOUSLY

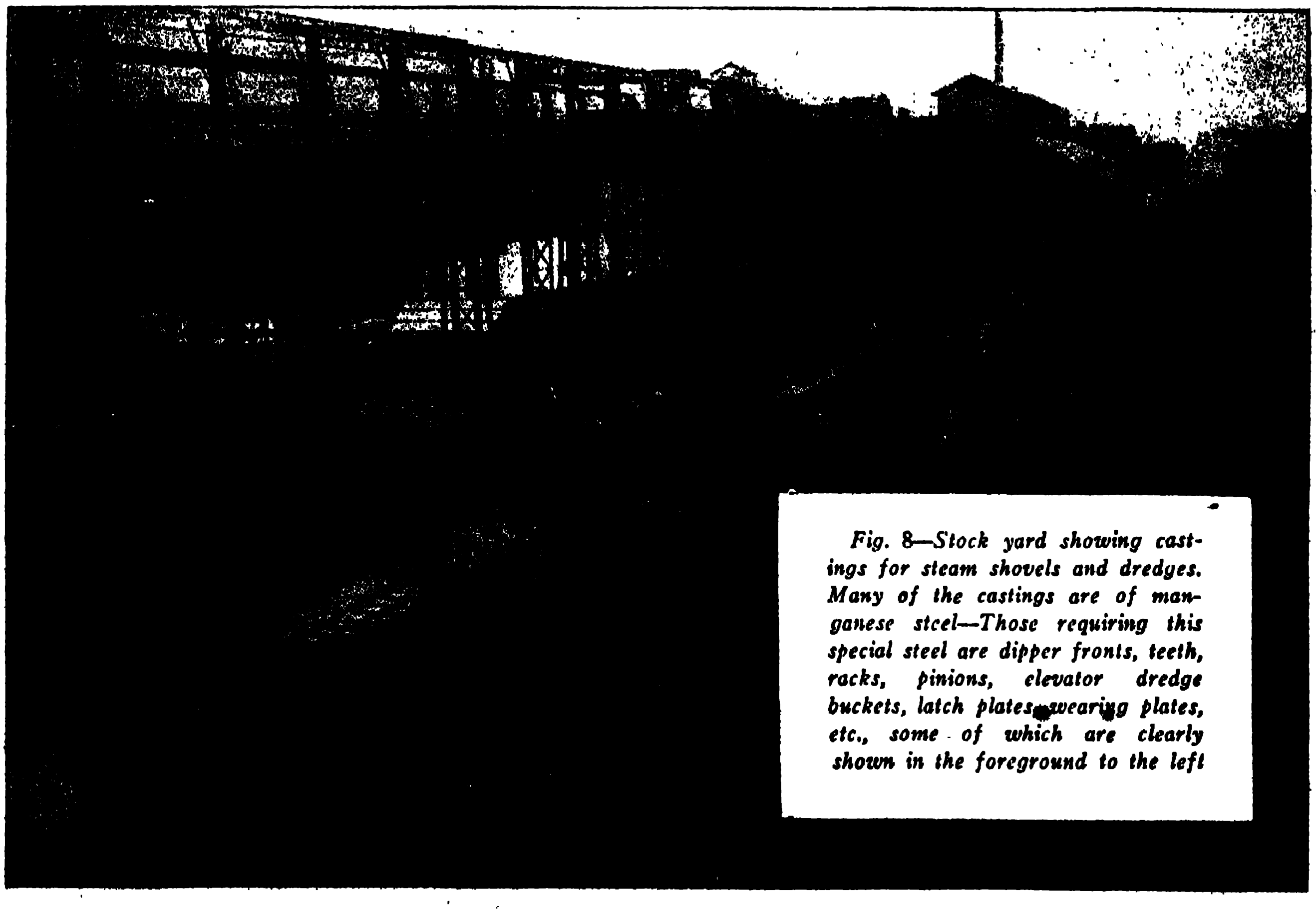


Fig. 8—Stock yard showing castings for steam shovels and dredges. Many of the castings are of manganese steel—Those requiring this special steel are dipper fronts, teeth, racks, pinions, elevator dredge buckets, latch plates, wearing plates, etc., some of which are clearly shown in the foreground to the left

made and if no defects are revealed the castings are considered satisfactory for use. In case the test indicates that undesirable qualities still are present, the entire heat is thrown out.

Although comparative costs of the bessemer and open-hearth processes for making manganese steel are not available, the estimates made by the company based upon melting losses indicate that the open-hearth process is as economical if not more so thar the more generally used converter method for making the same castings.

The steel foundry of the Marion company is in charge of Marshall Post, and the laboratory work and all problems pertaining to the metallurgy of metals are under the direction of Ralph Young, metallurgist.

How Tie Rods for Ore Docks Were Welded

THERMIT welding was employed by the Algoma Steel Corp., Ltd., Sault Ste. Marie, Canada, in an emergency last July. It was necessary to make 13 pieces of 3¼-inch square rods by welding four pieces together in each case. This required three welds for every rod, making 39 welds in all. When finished they were to be used as tie rods from a concrete ore dock to an anchor wall. This required a length of 185 feet. The nature of the subsoil and the excessive loads of ore placed in storage back of the dock made it necessary to get a substantial tie-back to prevent any slip in the concrete wall. Therefore, any defect in the weld which would have caused weakness and allowed the bar to break would have been serious.

Tensile Tests Made

Three tensile tests were made of thermit welds with the following results:

	Tensile strength Lbs per sq. in.	Elongation % in 2 in
Original bar	48,560	52.5%
No. 1 weld	27,000	2.5%
No. 2 weld	52,200	6.0%
No. 3 weld	44,880	4.0%

The average tensile strength of these tests show the bar to be 85 per cent as strong in the welded sections as it was in its original form. Sample No. 1 had a slight pipe in it and the result of the test would indicate that this probably caused a considerable reduction in its strength. In preparing the sections for the tests of the newly welded portions, a short piece of the 3¼-inch square rod about seven inches long containing the weld was cut out. This was put in a crank shaper and machined to flat surfaces on three sides. It was then put under a power hack saw and quartered. Three of these quarters were then turned down to test pieces having cross sectional area of 0.7854 square inch, or about 7½ per cent of the cross area of the original bar.

The results of these tests decided the Algoma company to use the thermit process for welding the bars in spite of the difficulties to be encountered in the application of this method of welding. Boats were due at the dock within a week and the water was high, with not sufficient time to properly cofferdam each weld. However, by the use of a steam pump and constant bailing, the water was kept low enough to get at the welds and work started on July 9. It was completed on July 17, in the following order:

July	Welds
9th	3
10th	3
11th	5
12th	5
13th	5
14th	5
15th	5
16th	5
17th	3
Total	39

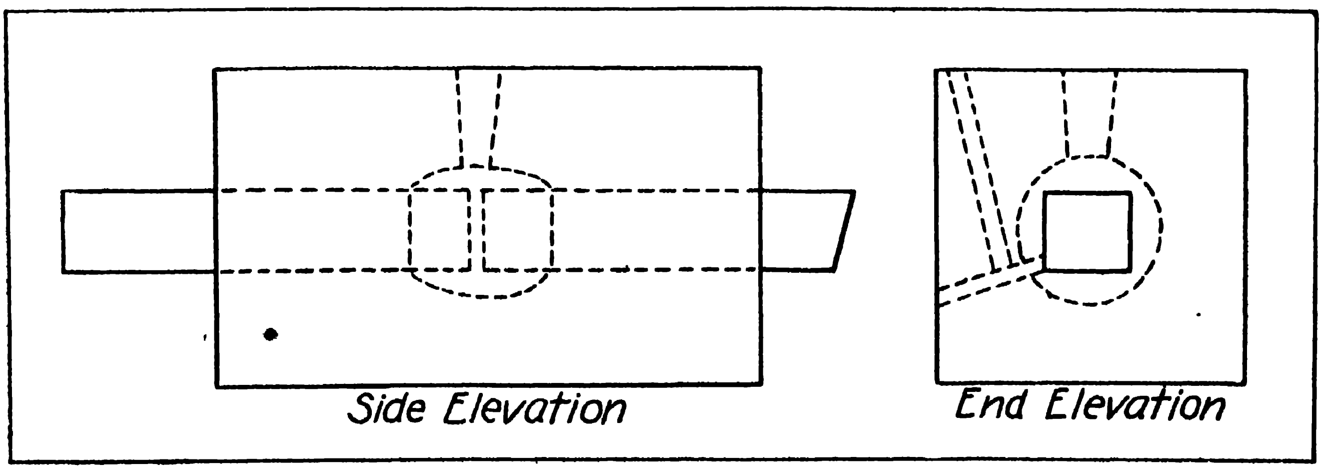
This work was done by Charles Fosberg with a force of six workmen. About 40 pounds of thermit was used for each weld and, on an average, two hours were required for heating a weld. The accompanying sketch shows roughly a mold on place on a bar with the method of gating.

Venting Method Provides Free Passage

By J. C. Klohn

A device which can be used to advantage in cores which are difficult to vent is made from fly screen and bees wax. For example if a vent is needed 2 x ¼ x 24 inches, cut a strip of common fly screen 6 x 24 inches and run it through melted bees wax which will fill all the square mesh. When the wax has set, make three folds on the 6-inch width and the vent will be complete. This vent may be bent to any desired shape and rammed up with the core. The heat of the oven will melt the wax and leave a clear open vent through the core. The vent may be made any size or shape necessary. If a large vent is wanted the space between the folds may be filled with hay, straw, or burlap to provide greater strength when the mold is rammed.

The American Metallurgical Corp., Franklin Trust building, Philadelphia, has closed a contract with the York Hardware & Brass Works, Inc., York, Pa., for the installation of a 1000-pound revolving electric Weeks furnace for melting brass and copper alloys in its nonferrous casting plant.



CONSTRUCTION OF MOLD BOX FOR WELDING TIE RODS, SHOWING METHOD OF GATING

Melting Brass in a Gray Iron Shop

Considerations That Should Govern the Occasional Production of Nonferrous Castings and the Importance of Correct Melting are Emphasized —Types of Melting Mediums and Methods Described

BY R. R. CLARKE

PROPER melting stands preeminent among the factors entering into successful brass foundry practice. More defective castings result from poor melting methods than from all other causes combined. It is a foundry axiom that "some molders make their own scrap but furnaces can make scrap for everybody." The importance of providing proper equipment and of supervising the operation cannot be over estimated. It is not the purpose of this paper to discuss in intimate detail every phase of brass foundry practice. It simply covers in a general way the features confronting those who have, or who contemplate installing a brass melting unit in their iron foundry.

Every detail has its melting peculiarities both when in a single and combined state. These peculiarities must be kept constantly in mind for they have a direct bearing on the final results. It is a common, but not commendable practice among iron foundrymen to use loose brass scrap of unknown composition. A pile of miscellaneous scrap may contain samples of yellow brass, red brass, Tobin bronze, manganese bronze and several other varieties. A composition of this character when melted yields bad metal with physical characteristics which render it unfit for any definite use.

Judging Brass Scrap

Experienced brass men can judge brass scrap fairly well by the color, appearance and fracture. The best brass foundries do not depend upon the judgment of anyone. They either maintain laboratories of their own or they have samples of the metal analyzed by commercial chemists before using it. The safest course for the executive of an ordinary iron foundry which handles brass only as a side line is to purchase brass scrap metal ingots of known analysis. The price is but slightly higher than that of loose brass scrap.

Broadly speaking, scrap ingot may be divided into two classes, that containing an appreciable quantity of zinc and that containing little or none. Zinc is needed in the production of golden colored metal, in most castings subjected to pressure and in those where softness and toughness are desired. Tin is substituted for zinc in castings where hardness and bearing qualities are needed.

If the iron foundries doing occasional brass work would keep two kinds of ingots on hand, the one inclusive and the other exclusive of zinc, and at the same time carry a limited stock of virgin copper, tin, lead and zinc they could approximate at reasonable cost a high grade alloy of almost any desired constituency. They could do this by adding one or more new metals at the expense of others in the ingot as the case might require. Out of an ingot approximating copper 80 per cent, tin 10 per cent and lead 10 per cent, which is an excellent bearing metal, they could by adding 90 pounds of copper and 10 pounds of zinc to 100 pounds of the ingot realize a high grade red brass applicable to the average purpose. This metal would approximate very closely the formula copper 85 per cent, tin 5 per cent, lead 5 per cent, and zinc 5 per cent, which is quite common and reputable in brass foundry work.

When loose and indiscriminate scrap must be used some effort at least should be made to pick it over and secure the best for the more particular cases. The better grades of brass usually will be found in such castings as valve bodies, stems, disks, bonnets, glands, plugs or keys; and also in the better class of plumbing goods, in locomotive steam castings and in most cases where the casting is known to have rendered some particular red brass service.

In making up alloys altogether from new metals, the order of adding the metals is important. The general and safe rule is to melt the copper to a fair liquid state, add the tin and lead and finally the zinc, stirring the bath well during the entire process.

The eternal vigilance of the brass foundryman is required to prevent his alloys from being contaminated with iron. Its presence is detrimental to all nonferrous mixtures with the possible exception of Parson's manganese bronze which carries an average of 1 per cent iron.

Brass may be melted in a pit furnace with a crucible using either natural or forced draft. The air and oil furnace, the gas-fired furnace, the electric furnace and in some cases the cupola also are employed. Pit melting with proper equipment is efficient, but at the same time is expensive, owing to the high cost and comparatively short life of the crucibles. Certain relative dimensions must be observed in building a pit furnace and something more than a mere hole in the ground lined with fire brick and connected with a stack is required.

Melting Practice

Good practice in pit melting consists in maintaining a uniform and substantial coke bed under the bottom of the crucible; in keeping the crucible in an upright and central position; in using care to prevent coke from falling into the metal and in excluding the air from the surface of the molten metal. One of the most efficient and best known measures for accomplishing this purpose is to cover the exposed surface of the metal with powdered charcoal. Pulverized glass is sometimes used, as it melts and forms an ideal cover.

Pit melting expense can be greatly reduced by proper care of crucibles. In this connection the following hints are pertinent:

New crucibles and crucibles not in use should be kept in a warm, dry storage room. In an ordinary shop the core oven is the best place.

Crucibles should be properly annealed before using. Proper annealing consists in raising the temperature slowly to at least 150 degrees Cent. The surface also should be heated uniformly. Care should be observed to avoid striking them with the bar when poking the fire.

Pigs or chunks of solid metal never should be forced into a crucible in wedge formation.

Heels of metal never should be allowed to freeze in the crucible.

Tongs should be made to fit the crucible snugly and kept in proper condition.

Throwing heavy pieces of metal into the crucible carelessly is destructive practice.

When melting with gas or oil the crucible should not be left in the path of the flame jet.

Pit melting by gas instead of coke is quite practical, the only factor to be considered being the relative cost of fuel. Insofar as the quantity and

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Abstract of paper presented at the Philadelphia convention of the American Foundrymen's association Sept. 29–Oct. 3, 1919. The author, R. R. Clarke, is with the Eagle Brass Foundry, Seattle, Wash.

quality of the resulting molten metal is concerned there seems to be little if any difference.

Melting with oil, when properly handled, is an efficient and convenient method. Dependable auxiliary equipment is essential to its success. A satisfactory air supply is indicated by ample volume rather than by great pressure.

The proper flame, which means the correct proportion of air to oil, is judged best by the color. A flame which is too white and clear or one tinged with green is oxidizing and decidedly detrimental. A soft flame, clear and almost smokeless, faintly tinged with yellow is to be preferred. The temptation to conserve oil is always strong but it is well to remember that oil is cheaper than metal.

Operating the Furnace

The following points should be given careful attention in operating any type of oil furnace:

Keep the furnace clean. Slag out and clean it after every heat.

See that there are no defective or bare spots in the lining.

Do not permit too much slag to accumulate on the molten metal.

Watch the flame closely and maintain a moderate reducing flame.

Use a good grade of oil.

Do not allow the air to be turned on while the oil is not being supplied.

In melting large heats change the position of the furnace frequently by rocking it.

Never expose the metal to the flame after the pouring temperature has been reached. Soaking metal is one of the primary evils of melting and a prolific cause of defective castings.

Melt and dispose of the metal as quickly as possible.

Keep the surface of the metal covered with charcoal.

After the bath has been reduced to a fairly liquid state open the furnace, skim off the accumulated slag and dross, throw on a good sized shovelful of coarse charcoal. This is the only interruption that should occur during the melting process.

When transferring metal from the furnace to the mold, the ladles should be clean and well preheated. The surface of the metal should be kept covered with fine charcoal.

Cupola melting has never been favorably considered by brass men. It is feasible and where a large quantity of metal is needed at one time quite practicable. We have found it so in melting foundry sweepings, screenings, etc., and we know of high grade manganese bronze having been made in the cupola. In making this latter metal the copper was melted in the cupola and the zinc stirred into the hot copper bath after it was in the ladle.

The two principal evils attending brass melting are oxidation and gas absorption. Practically all known metals at certain temperatures combine readily with oxygen, producing either an oxidized metal or a complete metal oxide. The difference between "oxidized metal" and metal oxide is that between a metal only partially oxidized and one completely oxidized. In the one case the metal is scorched and in the other it is completely burned to dross or ashes. Oxidation increases with temperature, with exposure and with time. To minimize oxidation in melting then means to get the metal no hotter than necessary, keep its surface well protected from the atmosphere and get it out of the furnace and poured as soon as it is ready. Oxidation causes weak, drossy and spongy metal, wholly unfit for any general purpose.

Gas absorption consists in the taking up of gases by molten metal at high temperatures and releasing them in the process of solidification. The active and expelling stage of these gases is strong in the plastic state of the metal and results in a most distressing honeycombed and porous effect in the casting. Though given considerable study by both practical and technical men, the nature and origin of these gases have not been definitely determined or at least agreed upon. That they are allied more or less intimately with oxides and oxidation seems fairly certain since they arise from similar conditions and respond in part at least to like cures. A fairly complete discussion of their nature, cause, prevention and remedy will be found on page 121 of the March, 1919, issue of THE FOUNDRY, and those interested may find this discussion of value It is only necessary here to remark that this condition is usually characterized by a swelling up of the gate head in cooling and follows such evils as poor grades and bad combinations of metals, dirty and slag-polluted furnaces, damp furnaces and ladle linings, poor grades of fuel, soaking the metal, and extremely high pouring temperatures.

The rule is fairly general, though not infallible, that a correct pouring temperature will offset the evil even though the metal at that temperature represents reduction from a higher one.

The cure lies in the fluxes, which are of two kinds, neutral and active, representing respectively those that do not become a corporate part of the metal nor alter its inherent properties and those that do. Of the neutrals, the most common are charcoal, plaster of paris, and common salt used principally as surface coverings.

Charcoal is carbon and at its kindling temperature has a great affinity for oxygen. Oxides floating on the surface of the metal are combinations of oxygen and metal. The function and power of charcoal is to take up the oxygen of the oxide and leave the metal clean and clear. This it does admirably, besides forming a protective covering to exclude the atmosphere. Charcoal's greatest value is in the burning which represents the chemical reaction or oxidizing process. Obviously then the top of the metal in the ladle should be well covered during pouring, with charcoal in a burning state. Once burned to ashes its function practically ceases.

Active fluxes are sometimes referred to as reagents and deoxidizers. Always they are highly oxygenating substances. Most common among them are zinc, phosphorus, silicon, magnesium and manganese. But three of these will require comment here, they being the most widely used and covering general requirements. If pure copper is melted and poured into molds, the chances are greatly in favor of its rising and flowing back through the pouring gate, resulting in a porous and oxidized casting. If to this pure copper, 3 per cent of zinc, or ½ of 1 per cent of phosphorus, or a small amount of silicon are added, the evils will at once be corrected. In the copper tin-lead alloys, zinc or phosphorus only are used.

Zinc seldom is used for deoxidizing purposes exclusively while phosphorus exclusively is commonly employed. The reason is that in a great many alloys zinc is used for the quality it supplies and because its presence obviates the need of any further reagent. With phosphorus, this is not the case. It is used purely as a deoxidizer in those alloys from which zinc and its qualities are barred. Zinc quality is wanted in pressure-resisting metals, so it forms an equal part with tin and lead in the 85 copper alloy. It is not wanted in a bearing metal, so the 80-10-10 copper, tin, lead alloy is fixed up with from 0.5 to 1 per cent of phosphorus. The use of both zinc and phosphorus in the same alloy is considered bad practice, especially high percentages of either. Used purely as a deoxidizer from 2 to 5 per cent of zinc and from 0.25 to 1 per cent of phosphorus will suffice.

Zinc and Phosphorus Burn

With high temperatures and repeated remelting, both zinc and phosphorus burn out of the alloy. In melting all scrap it is therefore good practice to add small quantities, from 1 to 2 per cent of zinc and 0.1 to 0.25 per cent phosphorus.

Phosphorus is added to the alloy in the form of a concentrate which itself is an alloy of either phosphorus and copper or phosphorus and tin and known respectively as phosphor-copper and

phosphor-tin depending on the base. Relying on phosphorus as a cure-all for loose melting practice is bad policy and it should be resorted to at times and in quantity only as unavoidable conditions require. Silicon is used almost exclusively with pure copper to reduce its gases and oxides. The use of manganese and magnesium is not widespread. Chloride of zinc is generally used as a covering and flux for aluminum.

Cleanliness and solidity of brass castings depend largely on the casting temperature. Cold metal causes shrinking, drawing, drossy and spongy metal and improper union between different metal sections of the same casting. A porous and honeycombed structure is often the result of pouring the metal at too high a temperature. There is a considerable loss of heat in carrying the metal from the furnace to the mold. It cannot be checked, but it may be retarded to a certain extent by furnishing clean, preheated ladles and by handling the metal as rapidly as possible. It may be regarded as a fundamental principle of good brass melting practice to get the metal no hotter than absolutely necessary and then pour it immediately.

Checking Mistakes in Stock Records

(Concluded from page 50)

should be 385 pounds on hand. To balance this discrepancy 385 pounds of iron were added to the report of iron used, Fig. 2, for the week ending Aug. 30. By this method the amount of pig iron is always accurately known and errors in weight are corrected. Stocks of coke, steel scrap and gray-iron scrap purchased, are recorded in a similar manner. But the scrap and sprues from the home foundry are handled somewhat differently. The amounts used and received are entered on a card each day and occasionally adjustments are made on the card based on estimates of the amount of hand. These estimates can be closely made at times when the stock is low.

Form Sales Corporation

The Shawinigan Products Corp. has been organized to handle ferroalloys and Canadian carbide in the United States. The new company will be controlled by the Canada Carbide Co. interests. Julian C. Smith will be president and L. F. Loutrel, formerly manager of the ferroalloys department of Fairbanks, Morse & Co., and vice president of the Canada Carbide Sales Co., will be vice president and general manager of the new company. The remainder of the personnel will be largely the same as that of the old Canada Carbide Sales Co. Temporarily the new company will be located at 30 Church street, New York.

The carbide plants whose product will be sold in this country by the Shawinigan Products Co. are those of the Canada Carbide Co. at Shawinigan Falls, Canada, and at Meritton, Can. The company also will sell the products of the Shawinigan Electro Products Co., Baltimore, and the Southern Ferro Alloys Co., Chattanooga, Tenn.

Bureau of Standards Will Promote Safety

As a result of the conference called by the bureau of standards at Washington, D. C., in December, it is probable that within a short time a definite start will be made in the formulation of uniform safety standards, beginning with those subjects on which rules are now being formulated or revised by state or other authorities.

The Washington meeting was attended by about a hundred representatives of trade associations, engineering societies, state industrial commissions and labor departments, government officials, large employers of labor, and insurance committees and bureaus. The program included a presentation of a large number and variety of conflicting safety codes in existence and an outline of the efforts which have been made thus far to secure uniformity. The conference voted unanimously to approve the plan of formulating safety standards under the general auspices of the American engineering standards committee.

To expedite matters the conference session voted that a general advisory committee should be formed to include representatives of all national associations, state commissions, and others legitimately interested, to survey the whole field of safety standards and recommend which standards should be undertaken first and what organizations should sponsor them. The conference further recommended that such representative committee be organized by the national safety council, the bureau of standards, and the International Association of Industrial Accident Boards and Commissions.

At an informal meeting of representatives of these three organizations, plans were made for organizing the general advisory committee at once. Information will be gathered as to what rules are now in existence in the various states and the general advisory committee will recommend that these subjects be given first attention. This committee will report to the American standards committee not later than Feb. 1, and the definite assignment of sponsorship to the national safety council, the bureau of standards and others will follow.

Building Large Foundry

The new additions now being constructed at the gray iron foundry of the Universal Winding Co., Auburn, R. I., will make it one of the largest in that state. The complete foundry will be 470 feet long and 159 feet wide. Additions now under way will provide facilities for melting 50 tons of metal per day and the equipment for all foundry purposes will be the most modern obtainable. Two additions comprise the extension to the present building and these will practically double its capacity both in space occupied and in general equipment.. E. F. Parks is general superintendent.

Mines Domestic Graphite

A company with a capital of $250,000 has been formed to purchase and operate the graphite mine and mills owned by Hooper Bros., Whitehall, N. Y. The company will continue the manufacture of flake graphite and has already in operation a large concentrating plant built in 1916. The mine according to the report of the New York state geologist contains 1,500,000 tons of available ore. The refining plant is situated on the main line of the Delaware & Hudson railway and it is expected that this plant will be enlarged in the near future to care for the manufacture of paints, greases and other associated lines. The officers of the company follow: President, Frank C. Hooper; vice president, Roscoe B. Hayes; secretary, Frederick B. Richards; treasurer, Geo. Hooper.

A Correction

The furnaces and lifting lever at the foundry of the John Harsch Bronze & Foundry Co., shown in Fig. 8 on page 917 Dec. 15 issue of THE FOUNDRY were installed by the Foundry Equipment Co. of Cleveland and instead of the American Foundry Equipment Co., New York, as was stated.

The Vancouver Pipe & Foundry Co., Ltd., Vancouver, Canada, has been purchased by J. S. Tail of J. S. Tail & Co., Ltd., that city.

How and Why in Brass Founding

By Charles Vickers

Shrinkage Cracks in Chill-cast Aluminum

We have been trying to cast aluminum around a steel core, but find that as the metal cools it will crack, owing to the great contraction. We melt scrap aluminum from crank cases. We would like to learn if this difficulty can be overcome by the use of a different mixture of aluminum, and if not whether there is any other manner in which it can be avoided.

There is no way of overcoming the cracking of aluminum cast around a steel or other rigid core, provided the metal is allowed to cool on the chill. The practice in casting nonferrous metals is to pour the metal into a mold, let it cool until cold, or partially cold, then stripping the casting and cleaning out the cores. This practice will not bring good results when non-collapsible cores are used. In this case, it is necessary to have the mold mounted on a machine that will enable the cores to be positively and quickly withdrawn when the metal has reached a certain stage of solidification, and before the contraction that causes cracking begins. It is obvious the cores cannot be withdrawn by hand after shaking out the casting; they must be withdrawn by mechanical means, and this requires a "die-casting" machine. The only alternative is to devise collapsible steel cores made with a key piece in the center which is withdrawn after the core is set in the mold, and when this center is withdrawn the circumference of the core must be so designed that it will contract when squeezed. Made in this manner the core will not resist the contraction of the metal, and the casting will not be broken.

Nonshrinking Alloys

We would like to obtain the formula for a non-shrinking white metal suitable for match plates with the pattern cast on; also a good alloy of white metal for separately cast patterns.

There is no nonshrinking alloy. All metals and alloys shrink to some extent; some, however, less than others An alloy of 50 per cent zinc and 50 per cent tin, has little shrinkage and is the alloy usually employed for patterns. If 3 per cent bismuth is substituted for 3 per cent of the zinc in the mixture, the shrinkage of the alloy is further reduced. The shrinkage is perceptible in the case of long patterns, but for the ordinary run of castings made from patterns in white metal, the shrinkage is too small to notice.

Another so-called nonshrinking white metal of a different character consists of tin, 45 per cent; lead, 45 per cent; antimony, 5 per cent; bismuth, 5 per cent. In running the zinc-tin alloy, if a small piece of sheet aluminum about one inch square is dissolved in the bath the alloy will produce cleaner castings.

What is Aterite?

We have received an inquiry for castings of a special metal known as "aterite," which is claimed to be noncorrosive and is used principally for couplings, valve fittings and the like. The alloy has a black appearance which makes it unattractive to thieves, but internally it looks like brass. It is claimed that this metal as scrap is objectionable should it be mixed in a pot of regular red brass. We would appreciate any information you can give us.

Aterite is a nickel silver low in nickel and containing both iron and lead. It contains 4 per cent of iron and it is this metal which makes its use objectionable in brass or bronze because this amount of iron will blacken the castings, even if only a small addition of the aterite is made. The iron also probably would segregate in nodules of extreme hardness which would make machine work difficult.

It would be advisable to purchase the metal in ingot form from the manufacturers and then to recast it in your foundry, as alloys of this character are difficult to make unless the exact formula used by the manufacturers is known. If the metal is bought as ingot from the makers, they will be interested in your success in making the sand castings and will freely extend counsel that will enable the work to be carried out in a satisfactory manner. A fair imitation can be made by adding iron and lead, the latter in small quantity to low grade nickel silver scrap. As nickel is expensive the alloy is not cheap.

Phosphorus Detrimental

We recently melted 250 pounds of good scrap brass in an oil-fired, open-flame furnace. We charged 4 pounds of boronic copper No. 3 with the metal and shortly before pouring we added 5 pounds of 15 per cent phosphor copper. The melting was done under a flux of salt, borax and charcoal and the metal was poured very hot. The castings showed a very poor crystallization and when examined under a strong glass showed many hair cracks. Can you give us an idea of what caused this trouble?

The poor crystallization, and most probably the hair cracks also were caused by over deoxidizing the alloy. As scrap was used entirely, it was no doubt largely composed of red brass which is an alloy of copper with varying percentages of tin, zinc and lead. This mixture will not stand much phosphorous and as the boronic copper contains phosphorus there was no need for the phosphor copper.

It would be advisable to omit the phosphor copper entirely, in future heats, or to omit the other deoxidizer and simply add just before pouring at the very most, only 0.25 per cent of 15 per cent phosphor copper. If this change fails to correct the difficulty, omit all phosphorous deoxidizers and use instead 0.25 per cent of 30 per cent manganese copper, A grade. The manganese copper can be used in amounts up to 0.5 per cent, but the increase over 0.25 per cent should be made with caution; the fracture being the guide.

Aluminum Alloy Numbers

We wish to be advised as to the meaning of the various numbers by which aluminum is known, such as No. 12 aluminum and No. 31, or No. 80 aluminum?

The term No. 12 alloy aluminum is well established as the trade name for an alloy containing copper in the proportion of about 8 per cent. The term No. 31 also is often applied to an alloy consisting of 3 per cent copper; 15 per cent zinc, and 82 per cent aluminum. The term No. 80 aluminum is never heard and when this term is used, it should always be accompanied by the chemical specification of the alloy.

Castings for Ship Construction-XVIII

Two Part Built-Up Box is the Best Medium For Molding Cast-Steel Stern Frames — Elevating the Box at One End Facilitates Pouring and Feeding Operations

BY BEN SHAW AND JAMES EDGAR

THE type of stern frame shown in the accompanying illustration is generally adapted to freight steamers. The tendency is toward simplicity of design without sacrificing the requisite strength. The desire for economy, not only in the labor necessary to construct the vessel, but in changes which occur through damage after the vessel has left the builder's hands, has resulted in more attention being paid to the design of parts in the structure which are likely to be fractured. Changing the design is not intended primarily to resist possible fracture, though that is of course a consideration. The change is intended rather to reduce the area which may be affected. In this way, when damage does occur the cost of repairing the vessel is reduced to a minimum. Alterations are being made in the general shape of some of the castings used in ship construction and this is particularly true in the case of stern frames. It has been customary to supply large stern frames, comparatively plain in design, for cargo carriers. In some cases the whole stern is formed by one casting.

Experience has proved that when a vessel that is so constructed fractures her stern frame, through collision or grounding, considerable expense is incurred in its replacement, because not infrequently, the nearest port to which the vessel is taken for repairs has not facilities for turning out large steel castings. A smaller type of stern frame gradually is being introduced for this class of vessels.

From an economical point of view the design selected has many advantages. It is not likely to fracture, but should fracture occur it can be replaced more readily. Many iron foundries have extended their plants to include steel casting units and are capable of dealing expeditiously with castings about this size. An increase in the number of possible producers, decreases the time it might be necessary to wait for a suitable casting.

In making one of these castings the time element generally is the most important and care and judgment are necessary to see that quality is not sacrificed to speed. The type illustrated lends itself to the method known as casting on an incline, and since substantial risers are necessary on the boss, the end of the flask nearest the boss is raised. This method requires a two part flask, and if available, a built flask is the best for the purpose.

Some foundrymen prefer a drag deep enough to take in the complete frame. The joint then is made to follow the top contour of the pattern and down to the center of the boss. Such a method increases the cope life considerably and requires additional support to carry the sand. The advantage of the method lies in the fact that the joint usually coincides with the top of the drawbacks necessary to form the channel sections.

Other foundrymen display a preference for flasks in which cope and drag are the same depth. With this type the mold will be in two symmetrical halves, coinciding with the joint of the pattern which has been

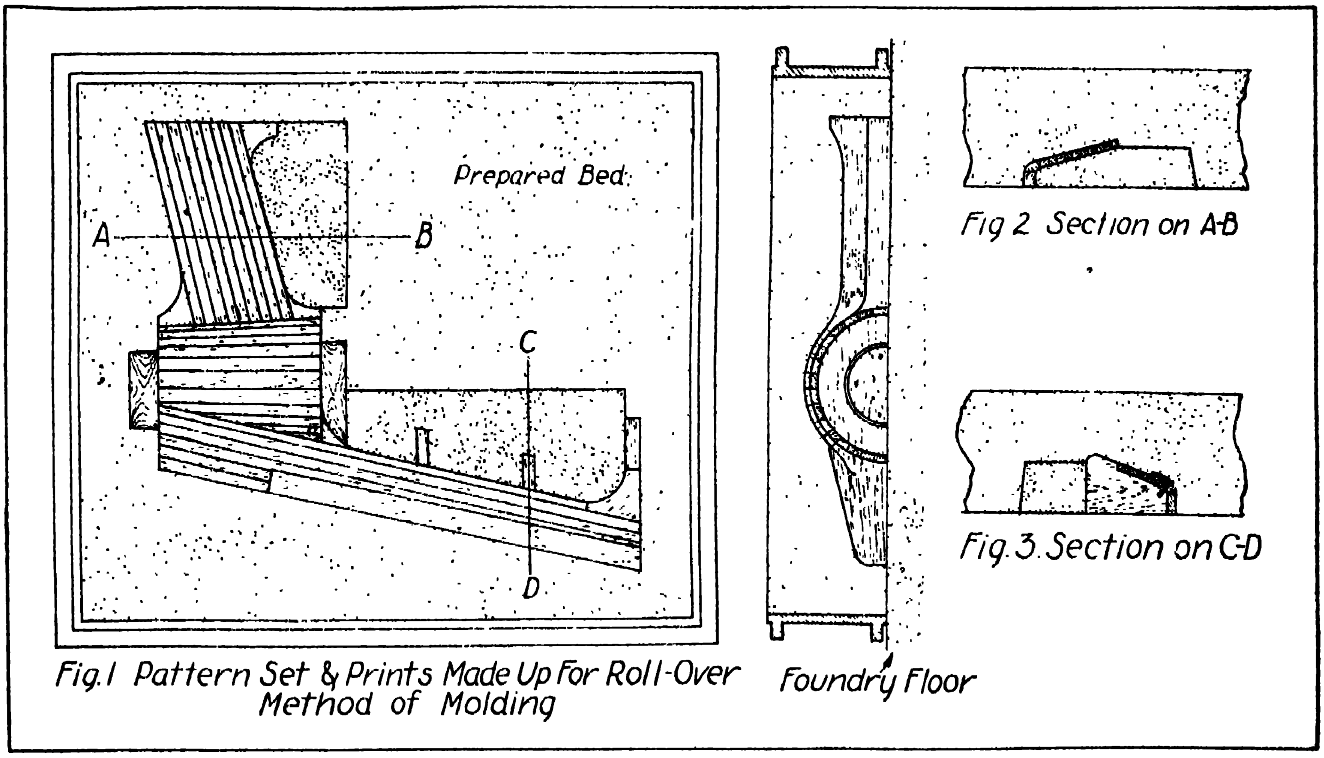


FIG 1 - PATTERN SET AND PRINTS MADE UP FOR ROLLOVER METHOD OF MOLDING FIG 2 - SECTION ON A-B FIG 3 SECTION ON C-D

split longitudinally on the center line. This method has the advantage of a level joint, and since it is more easily prepared and requires less labor than the other method it more frequently is resorted to when the necessary flasks are available. Its only disadvantage is that the drawbacks project well above the joint and necessitate considerable care in closing. This objectionable feature may be minimized by the use of long guides.

The practice of bedding such a job in the foundry floor is still prevalent in many foundries. This method necessitates fully as much labor as either of the other methods, a greater number of risers will be found necessary and the only advantage it has is that no drag flasks will be needed. When facilities are available and the size and character of the work permits, it is better to use a two part flask so that the casting may be poured on an incline. That is the method which will be described.

Using a Two Part Flask

A level bed is prepared on the foundry floor upon which the drag half of the pattern is laid, joint side down, as shown in Fig. 1. This tends to stabilize the pattern, especially if it is of a fragile nature. The drag frame of the flask is set in position to locate and determine the shape of the bars which will be required. It then is removed temporarily and while the bars are being sorted out or prepared, sand prints may be formed for the drawbacks. Bricks are used to build up the shape, the webs are packed to resist the ramming, and the prints shaped with floor sand. Wet parting sand is spread over the prints to form a parting. The shape of these prints corresponds to what dry sand core prints would be if dry sand cores were used; that is, they follow the inside contour of the pattern web as shown in the sections *AB* and *CD*, Fig. 3. The pattern made up with the improved prints is shown in Fig. 1. The inside boss

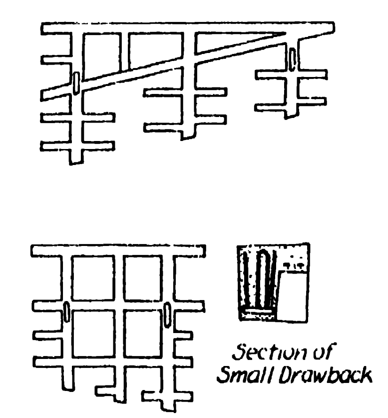


Fig 4 Drawback Grids

FIG. 4 DRAWBACK GRIDS

print which is shown should be partially covered with the sand print. The elevation shown in Fig. 1 illustrates the relationship between the flask part and the pattern with the bars removed. After the bars have been set in and bolted the ramming may be started.

The pattern first is covered with a prepared composite and then the flask is filled with successive layers of black or floor sand, each layer being rammed in turn until the box is filled. No gaggers or hooks will be needed, providing the lower edges of the bars have been cut out to conform to the shape of the pattern and about ¾-inch clearance allowed. The face of the mold may be nailed after the pattern has been withdrawn but this precaution is taken only to stiffen the skin.

Preparing the Drawbacks

When the box has been rammed and leveled off a number of screw-eyes which have been inserted in the top face of the pattern at suitable points, are secured with short rods and wedges across the tops of the bars, and the whole is rolled over. The screws are removed before the box is lowered, back down, upon a sand bed. The improvised prints, of course, will remain on the floor. They are of no further use. The print impressions left in the box are tapered and sleeked and a coating of parting sand applied. They then are ready to receive the sand for the drawbacks. Before commencing to ram sand in the drawbacks it is advisable to try the grids with the top or cope half of the pattern in position so that afterward they may be set properly. Suitable forms of grids for this purpose are shown in Fig. 4. Ordinary prods or gaggers may form an integral part of the exterior edge but it is better practice to cast pieces of wrought iron or steel rods in those parts of the grids which support the sand near the pattern. They are more pliable and may be bent to shape when forming the cores or drawbacks; they also offer less resistance to the crushing of the cores when the metal in the mold contracts.

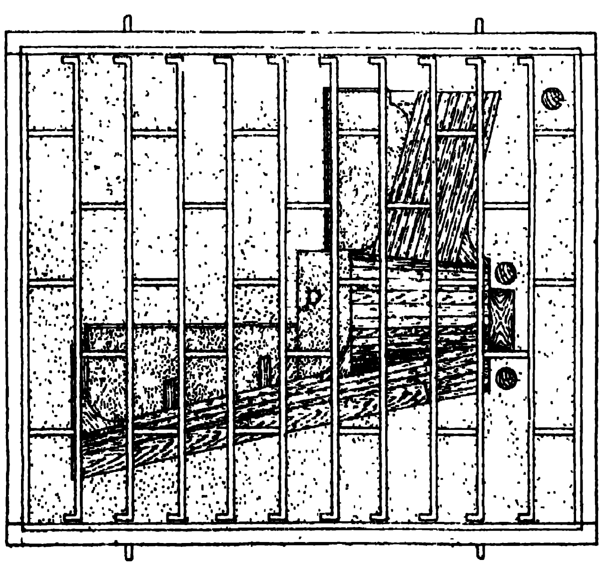


Fig. 5 Cope Arrangement

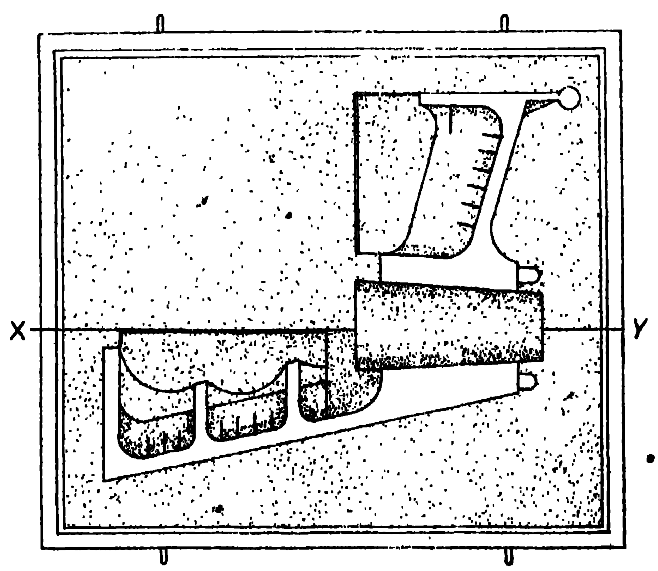


Fig. 6 The Mold Assembled Except Small Drawback

FIG. 5—COPE ARRANGEMENT FIG. 6—THE MOLD ASSEMBLED EXCEPT THE SMALL DRAWBACK

In designing the necessary grids this crushing action must be kept in mind and a generous margin of clearance allowed between the grids and the casting.

After the grids have been fitted and the rods all bent to suit, the cope half of the pattern is removed and the grids taken out. A thickness of wet composite is spread on the bottom of the drawback print and the grids replaced. The shell of the drawbacks is formed with composite about 2½ inches thick while the inside is filled with rammed ashes. When they are nearly up to the complete shape the top half of the pattern is bedded on. A small drawback is required over the top half of the boss core print cutting through the long drawback to the joint as indicated at *P*, Fig. 5. This arrangement is necessary to allow the center core to be lowered into position when closing the mold. The small drawback may be made to follow the contour of the boss and the tops of the other two drawbacks with which it comes in contact, and then graduated off to reduce the surface likely to interfere with a safe lift of the cope box.

When all the drawbacks are made up and allowed to stiffen, the cover, or cope flask is set on, and the work of ramming proceeds. Gate sticks are set near the junction of the rudder post and also two substantial risers on the boss. These should be given a rake so that they will be practically vertical when the job is canted for casting. After the cope has been rammed the same practice is resorted to in securing the top half of the pattern temporarily to the box, as was followed in the case of the drag. The ribs and the inside center core print are disengaged from the main pattern during the ramming process and remain in the drag when the cope, with the attached half pattern, is lifted off.

When the lift has been accomplished and the box rolled over, the cope half of the pattern is withdrawn and the mold is finished. Some patching probably will be necessary on the drawbacks left in the drag, but a clean withdrawal should be obtained from the pattern sections. The removal of the drawbacks carrying loose sections of the pattern will clear the drag half of the pattern, which then may be taken out of the mold.

When the mold is finished and all sharp corners of sand rounded off, the whole job may be transferred to the drying oven. It is well, however, to depress the joint surrounding the mold, and also cut out a number of contraction webs while the sand is green. A riser may be brought off from the uppermost point of the boss, but since the risers are connected with each other, a depression at the highest point is made in the cope, so that any gases that may be trapped will not interfere with the soundness of the casting.

It is customary to prepare the runner and riser basins and the center core while the mold and drawbacks are drying. The center core is usually made on a horizontal spindle in the manner described in previous articles. Iron rods are wired on before the last coat of composite is applied, to reinforce the core.

When a job like this is cast in the position indicated and the runners and risers are bunched close together, a single trough is frequently used. It consists usually of a rectangular plate with a slot in the center to take the gates and having a number of lugs on the outside for attaching the crane chains. A row of gaggers standing up around the edge serve to reinforce the sand. The runner and riser basins are shaped inside of these gaggers and are independent of each other. Bricks and composite are used to form the shape. Both center core and runner basin are dried.

When all the parts are dried and thoroughly cleaned, a good application of silica paint is given those parts which come into contact with the molten metal. The whole mold is then thoroughly dried. When taken out of the oven the second time the remainder of the mold is assembled. The two larger drawbacks are lowered into their respective positions, a couple of chaplets, equal in thickness to the required web being nailed to the bottom of the mold to support the overhang. The holes around the staples then are made up and dried with a hot brick. The center core is placed next, the top half of the small end being rubbed

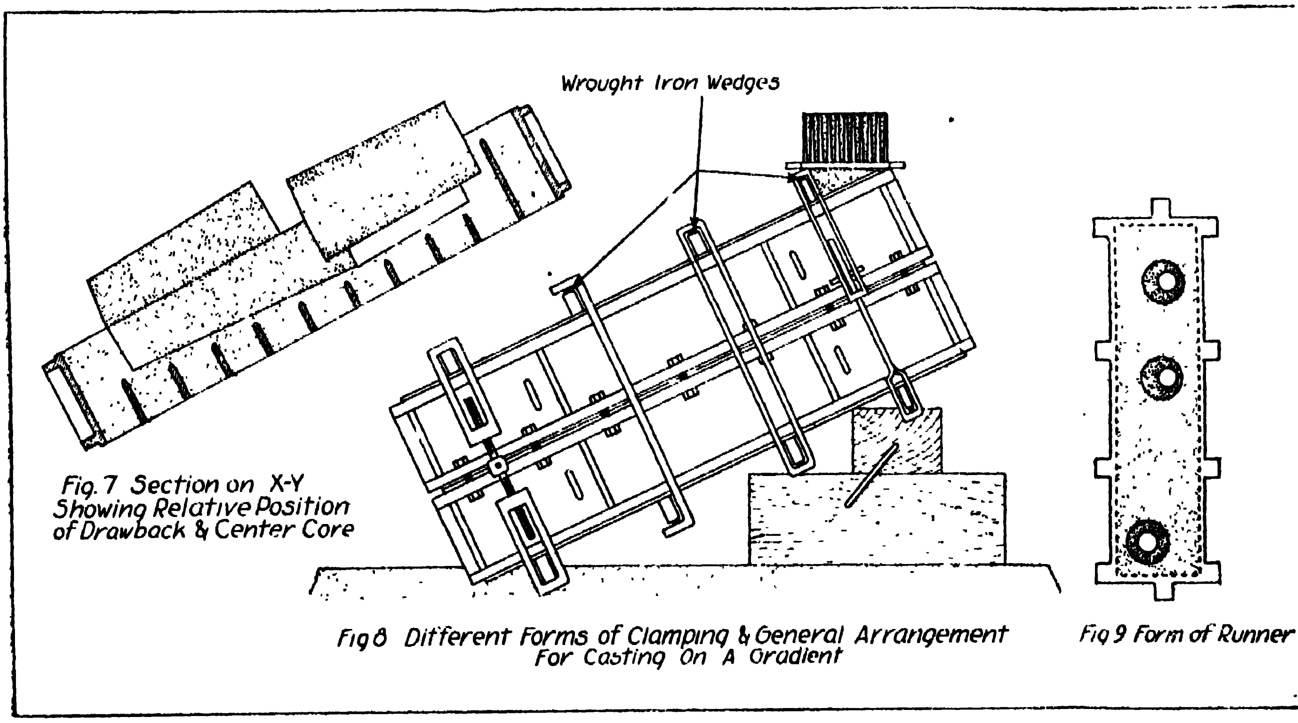


FIG. 7—SECTION ON *X Y* SHOWING RELATIVE POSITION OF DRAWBACK AND CENTER CORE FIG. 8—DIFFERENT FORMS OF CLAMPS AND GENERAL ARRANGEMENT FOR POURING CASTING ON AN INCLINE FIG. 9—FORM OF RUNNER

back to allow clearance for the final closing of the mold. A belt sling is a great convenience in handling cores of this description.

The last part to be lowered in is the small drawback covering the inside end of the center core. A plan of the mold assembled, except for this small covering core, is shown in Fig. 6. The contraction webs are shown by thick lines and the shape of a thickened fin is shown in contact with the webs of the frame and the divisional brackets. A section of the assembled mold is shown in Fig. 7, showing the clearance necessary on the parts projecting above the joint to prevent any possibility of crushing when the cope part of the mold engages them. A section of the small drawback also is shown in this illustration.

There are a wide variety of ways in use for securely fastening a completed mold of this character. The method shown in Fig. 8 is reliable and provides ample safeguard against the pressure exerted by the molten metal. A number of clamps are illustrated, adjustable and otherwise. It will be noted that the clamp on the lower end has a screw adjustment and is tightened by a *tommy* bar; the clamp on the upper end is tightened by wedges. The other clamps illustrated require packing at the bottom and wrought iron wedges at the top. In addition to the clamps, the flasks are bolted together at the joint as shown.

When the flasks have been firmly bolted and clamped, the end containing the boss is elevated and blocked up as shown in Fig. 8. A composite bed is prepared for the runner and riser trough. A plan of this is shown in Fig. 9. The preparation of this bed requires considerable care. Gate sticks are set in the existing openings, completely filling them to prevent any sand from falling into the gates. After the bed has been made up the prepared trough is lowered on to it so that the holes in both parts coincide. The inside junction is made up and coated with silica paint. Red hot plugs are used for drying these wet patches, they can be left in until just previous to pouring the metal. When the casting has been poured it is fed by way of the two headers.

It is necessary to devote considerable attention to easing a casting of this description. The flanges connecting the keel plate and the rudder post are large and at right angles to the direction of the strain set up when the metal is cooling. For this reason, the drawbacks must yield to the pressure. Few of these drawback grids offer suitable facilities for applying the wedged bar which holds the parts together until the wedge is withdrawn, a practice which is efficacious in relieving the strain in some types of steel castings. In this case access must be obtained to relieve the grids by hand. It is not necessary to wait until it is convenient to lift the cope flask. The drawbacks may be located from the outside. The sand and some of the short bars may be removed, in order to get at the drawbacks and ease them so that they will offer as little resistance as possible to the contraction of the casting.

Notwithstanding the care bestowed and the precautions observed in easing and slacking off the rigging around a casting of this description, internal strains will exist. However, an effort should be made to minimize the strain so that its amount does not exceed the ability of the metal to resist it. By careful attention to annealing, practically all these internal strains can be eliminated.

Gray-Iron Mixtures For Automobile Pistons

By H. E. Diller

Question—We would like to know a good mixture of iron for automobile pistons, which will give a good clean casting that can be machined easily.

Answer—We would recommend a mixture for automobile pistons castings made up of 50 per cent pig iron, 38 per cent clean cast iron scrap and sprues, and 12 per cent steel scrap. The steel scrap should not be thinner in section than ¼-inch and preferably not heavier than 1 inch. If the steel is too light it will oxidize and if too heavy it will not melt entirely while passing through the melting zone of the cupola. Should steel plate be used it should be cut into small pieces so as not to obstruct the course of the air through the cupola.

The pig iron and scrap should be of such a composition as to give an iron containing 1.75 to 2.00 per cent silicon; 0.150 to 0.250 per cent phosphorus, and 0.50 to 0.80 per cent manganese. Sulphur should be kept as low as practicable and should not run above 0.100 per cent if it is possible to keep it under this figure. Suitable pig iron can be obtained by using either the regular pig iron used for malleable castings, known as malleable bessemer pig iron, or the straight bessemer pig iron may be used. The phosphorus in the malleable bessemer pig iron will not be over 0.200 per cent, and in the bessemer pig iron it will be below 0.100 per cent. The sulphur should be under 0.05 per cent in both irons. It will be necessary to specify the amount of silicon desired in each order according to the amount required to bring the cupola iron to the proper composition.

After the right mixture is secured it is essential to see that the melting is carried on correctly. Care should be taken to have the bed of coke high enough and to see that there is sufficient coke between the charges. Commencing with the third charge, a flux should be used consisting of 40 pounds of limestone and 2 pounds of fluor spar to a ton of metal.

While all the details of mixing and melting the iron may be carried on perfectly, yet the castings will not be free from defects unless the casting is gated and poured properly. Often defects are blamed on the iron which are due to the methods of molding or of handling the iron after it is in the ladle.

Russia Rich in Graphite

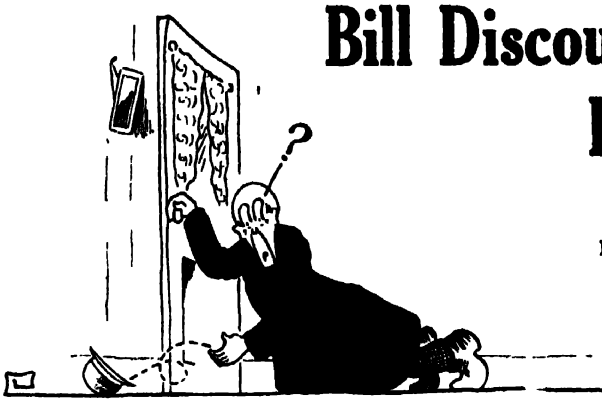
Extensive deposits of graphite exist in northwestern Siberia on the left bank of the River Kureika near its junction with the River Yenisei, 90 miles from the mouth of the latter river. The graphite area forms a horizontal plateau and contains two layers of graphite, which is of a solid steel-gray color, soft, and of an excellent quality.

The graphite mines of Siberia were discovered in 1859 by the explorer Sidoroff, who sent samples to Russian and foreign laboratories for analyses. These analyses gave the following chemical composition: 89.51 per cent carbon, 0.60 per cent hydrogen, and 9.89 per cent residue. These analyses were confirmed in 1907. The carbon constituent is said to be superior in quality to that found in graphites in some other parts of the world. The graphite is not inflammable and is quite plastic.

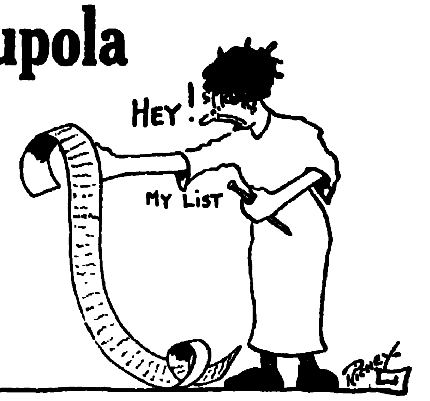
At present it is practicable to ship the graphite only in the summer months by sea from the Yenisei river through the Arctic ocean. It is believed that in the future the graphites from these mines will supply Russian demands and that large quantities will be available for export.

The chief sources of graphite now are Ceylon, Bohemia, Germany, France and the United States. The annual world production has been approximately 120,000 short tons.

The Tabor Mfg. Co., Philadelphia, recently moved into its new plant at State road and Devereaux street, where it is erecting an addition 100 x 108 feet. The company will be in the market for machine tools in the near future and is now preparing a list. H. W. Brown is secretary.



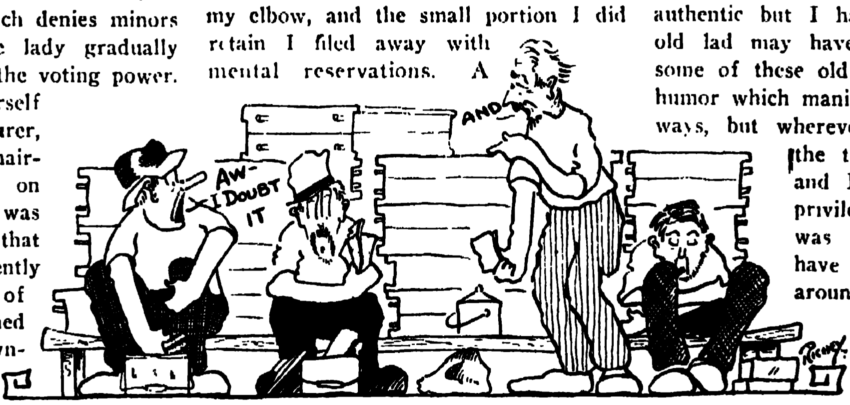
Bill Discourses On Cupola Blowing



BY PAT DWYER

SEVERAL years ago I helped to incorporate a company with a certain charming lady as a party of the second part. It was a kind of a gentleman's agreement, if you know what I mean, there was no regular board of directors or officers appointed. It was one of those agreements where it is tacitly understood that all mine is your's and all your's is your own. New members were taken in from time to time but on account of a legal technicality which denies minors the right to vote the lady gradually assumed to herself all the voting power. She also appointed herself to the position of treasurer, general manager and chairman of the committee on ways and means. It was in her official capacity that she approached me recently and handed me a list of things which she wished me to purchase downtown. I did not argue the point, but sallied forth. In the course of my perambulations, I met Bill bent on a similar errand. We combined forces and finally wound up in a restaurant with the laudable intention of absorbing some nourishment before heading for home. Our conversation dealt with children, their doings and sayings. I said it was a constant marvel to me where they got the inspiration for some of the questions they ask.

"Children don't ask all the funny questions," said Bill. "Listen! I worked in a shop in Newark, N. J., one time about 20 years ago. As the hero says in the melodrama, 'I won't mention no names,' but there was the front shop, the old shop and the new shop. It was popularly reported in foundry circles that they put the shiboleth test to all candidates for employment. If you could not say 'Aye' with the proper intonation when the shop committee put the question, 'Hae ye a car'r'r'd wi' ye?' you might just as well not go to work. It may have been that my accent was in my favor, or perhaps there was no truth in the report as I found them a pretty decent crowd of men to work with and I had the pleasure of quitting voluntarily when I felt the call to start on the southern migration. They made some nice work there, but of course nothing like what they were accustomed to make along Clydebank. Being young and polite in those days of course I listened patiently to all that was told me. However, I let most of it in through one ear and out through my elbow, and the small portion I did retain I filed away with mental reservations. A



SOME ONE STARTED A DISCUSSION ON BLOWERS

crowd of us were sittting one day on a long bottom board with our backs against a pile of flasks. We had just finished a dainty and *recherche* lunch, table-de-foundrie style. Some one started a discussion on the problems involved in melting iron and there were certainly some queer theories and experiences brought to light during that noon hour An old loam molder who had learned the trade in Motherwell, but who, like many of his countrymen, had been nearly all over the world since that time contributed the most extraordinary tale. He said that in his young days he often had watched the cupola blower operating in the smoke and grime and dust of the foundry and he was moved to wonder if better work could not be done if the fan were connected to a long pipe which would draw the air supply from outside the shop. He submitted the problem to a well known foundry authority and had received a voluminous reply. He quoted from it freely, using of course the foundry vernacular and as I afterward found out, adding many original embellishments.

"More to draw him out than for any other reason I told him that I doubted the whole story. 'A dinna as A can blame ye lad,' said he, 'but if ye care to ca' at the hoose the nicht A think A can convince ye—an' A have the document forby ta prove it.'

"I called at his house that night and he showed me the document. It looked authentic but I had my doubts. The old lad may have written it himself, some of these old birds have a *pawky* humor which manifests itself in curious ways, but wherever he had found it, the thing appealed to me and I asked him for the privilege of copying it. He was quite willing and I have carried the document around with me ever since." Bill reached into one of his hip pockets and produced one of those long leather bill folds in which people who are lucky enough to have it carry the long green. He selected several slips of paper and handed them over to me. The first one contained the question, "Does it make any difference if the air for the blower is taken from inside or outside the building?" The reply was as follows:

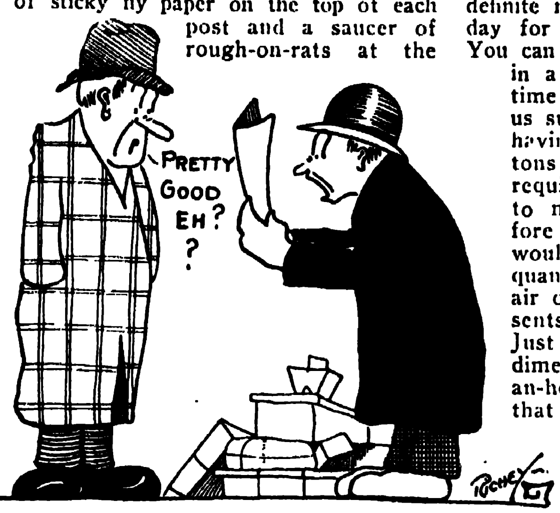
It would be rather difficult to formulate an opinion on such a peculiar problem without having first hand evidence. We would suggest that one of our experts be sent there to look the situation over and examine your air both inside and outside the shop. If you consider this plan impracticable, you might have a photograph taken showing a section of air entering the fan. In addition you might fill some small receptacle—say a pickle bottle—with samples of air taken at various points in the shop and have the same analyzed by a competent air doctor. We also will appreciate half a dozen micrographs of air sections taken at various temperatures. With these sources of information in our possession we will be in a favorable position to furnish an expert opinion.

There is no doubt in our mind that

under certain circumstances it is preferable to draw the cupola air supply from outside the foundry building. Where the men are addicted to eating garlic for instance, the heavily impregnated air entering the cupola has been known to stampede the pigs and ruin the heat. The same applies to some lines of tobacco and cigarettes to which molders as a rule are addicted. Pigs will stand for much abuse, including an impure air supply and it is difficult to know where to draw the line, but we should say that when they start jumping out through the charging door onto the stage, it is time seriously to consider the advisability of changing the source of the air supply.

Another possible source of contamination for air lies in the amount of elbow grease held in suspension in the foundry atmosphere. Where the intake to the blowers is not carefully guarded, some of this grease finds its way into the cupola with the result that the iron is rendered so slippery that it will not stay in the molds but comes pouring out at the joints of the flasks. This phenomenon usually is referred to as a runout and blamed either on a poor joint or insufficient rigging for holding the mold together. The fact that no molder ever was willing to admit that he was responsible for a runout caused us to investigate the proposition closely some time ago with the result that we are convinced that the elbow grease theory is correct. Perhaps the most important point which merits consideration when discussing cupola air supply in shops which are equipped with pneumatic appliances is the relative position of the blower and the air compressor. It will be apparent to any thinking person that a brand of air suitable for melting iron might be totally unfitted for pneumatic purposes, and vice versa. For metallurgical purposes an air high in oxygen and low in carbon is desired because the fuel furnishes all the carbon necessary for combustion, while for pneumatic purposes the chemical composition makes absolutely no difference. All that is necessary is a light mild brand which will compress readily and not crumple up or splinter. If the blower and the compressor should be placed close together, say in the same building, it is quite within the range of possibility that the air currents might get crossed resulting in confusion. Again, if the two machines are not carefully adjusted to run at the same speed it will not be at all surprising to find that one is robbing the other, or in other words using up more than its fair share of the available air supply.

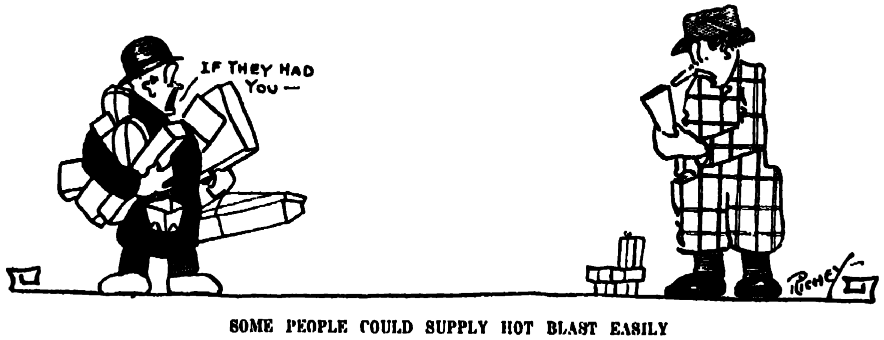
To offset any possibility of this occurring we recommend that the air inlet for the blower be carried through the north wall of the foundry and the intake for the compressor be led through the south wall. Absolute purity of air being one of the prime requisites for melting iron, it will be necessary to extend the blower inlet for a distance of at least 50 linear feet in a horizontal direction. Here it will terminate in a vertical tank, either round or square, a point which is left to the architect's discretion. This tank should be provided with a hood and a series of filter screens to remove any atmospheric impurities. As a further precaution it might be found advisable to surround the tank with a substantial barb wire fence of standard design, with a sheet of sticky fly paper on the top of each post and a saucer of rough-on-rats at the foot.



BILL BACKS HIS MEMORY WITH WRITTEN FACTS

It long has been recognized in scientific circles that rats and flies are fruitful sources of contagion and we have no doubt that many scabby and pock-marked castings are entirely due to contaminated and germ laden air which has been blown into the cupola and absorbed by the pigs whose pores were naturally open due to the intense heat of the cupola.

At certain seasons of the year when the rag-weed and goldenrod are blooming, the air is full of pollen dust and profanity. At this time special precautions must be observed in guarding the intake pipe. We strongly recommend that 0.0001 per cent by volume of hay fever specific in granulated form be added to each charge at those times.



SOME PEOPLE COULD SUPPLY HOT BLAST EASILY

An epidemic of sneezing among the pigs is something serious and is generally severe enough to wreck the furnace. Where large quantities of metal are handled, as in blast furnaces, explosion doors are provided for emergencies of this kind. Even with these precautions it is not uncommon during the height of the hay fever season to see the bell blown clear through the hopper.

As we pointed out these are only generalities or an outline of general conditions. Upon receipt of the data to which we have referred viz.: the analyses and micrographs of various samples of air, we can advise as to a definite line of action in your particular case. We are sure you will see the necessity of this course of action on our part. There are so many factors to be considered. For instance: In most countries at the present time there are laws on the statute books guaranteeing each factory and foundry worker a definite number of cubic feet of air a day for his own private consumption. You can easily see what would happen in a close crowded shop a short time after the wind went on. Let us suppose the cupola is rated as having a melting capacity of 10 tons an hour. We know that it requires 33,000 cubic feet of air to melt one ton of iron, therefore in one hour's time the fan would have drawn the enormous quantity of 330,000 cubic feet of air out of the shop. This represents a space 330 x 50 x 20 feet. Just contrast that with the dimensions of the ordinary 10-ton-an-hour foundry and you can see that you would not have a leg to stand on if the employes brought suit for compensation.

I folded the papers and handed them back to Bill.

"What do you think of that for a spiel?" said he.

I gathered up my parcels and edged toward the door. "Well Bill," I said, "I know one thing and that is if they had you in the shop they would not need to go to the expense of running an intake pipe through the north wall of the building."

Zirconium in Steel

According to a recent issue of *Le Genie Civil*, zirconium and its alloys dissolve completely when added to molten steel. The ferrozirconium thus obtained possesses an unusual degree of strength which has made it useful for the manufacture of armor or any form of sheet metal for defensive purposes. Armor made of nickel-zirconium steel having a thickness of 0.39 inch has shown the same resistance to the bullet as nickel molybdenum steel of 0.51 inch thickness or chronium steel of 0.63 inch thickness. The zirconium steel which has given the best results has the following composition: Carbon, 0.42 per cent; manganese, 1. per cent; silicon, 1.50 per cent; nickel, 3 per cent; zirconium, 0.34 per cent. It possesses a tensile strength of 250,000 pounds per square inch.

Where Risers Are Used to Advantage

How Feeder Heads Should be Located on Cylinder Castings—Other Features Such as Placing Chaplets, and Methods For Reducing Shrinkage are Discussed

BY M. H. POTTER

RISERS are placed on molds to feed metal to castings; to carry off dirt and slag in the metal and to indicate by the overflow of the metal when the mold has been filled. They also serve as an aid to check the pressure and velocity of the metal at the time of pouring. The number of risers on the mold always should be controlled by and be proportioned to the size of the pouring gates. The risers should be somewhat smaller in area than the pouring gates, as otherwise the pressure on the casting will be insufficient. If a mold is poured with the risers twice the area of the pouring gates, the casting will suffer from lack of metal compression. This is due directly to the insufficient pressure of the metal in the riser. It is axiomatic in foundry work to place the riser on the highest part of the mold. The metal thickness in this part of the casting may not necessarily require the location of a riser at this point, yet it is essential that the riser be located at the highest part of the mold to carry off dirt, slag and other impurities. On the other hand, it also is essential that risers be placed at other points of the mold where the variations from light to heavy sections are abrupt and for the purpose of feeding the heavier sections.

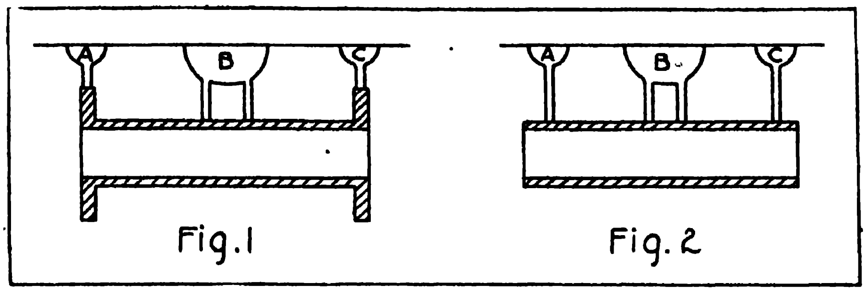
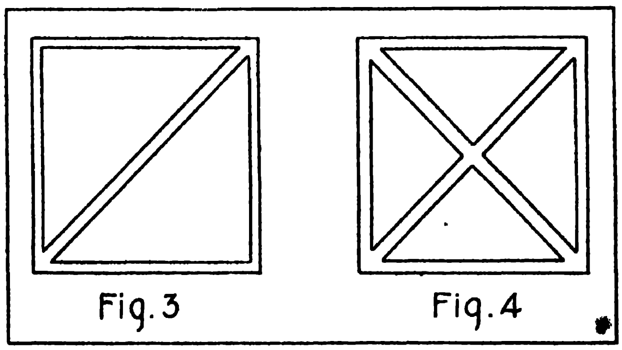


FIG. 1—WHERE RISERS SHOULD BE PLACED OVER A FLANGED COLUMN—THEIR LOCATION ON A PLAIN, CYLINDRICAL CASTING IS SHOWN IN FIG. 2

In Fig. 1 it will be noted that the riser, *C*, feeds a flange much heavier than the flange for which additional metal is to be provided by the riser, *A*. As this flange is the heaviest part of the casting and if no riser were placed in this part of the mold, the casting undoubtedly would be defective. The riser, *C*, should be oblong in form, should not be more than ½-inch wide or ⅛-inch less in size than the full thickness of the flange.

Fig. 2 is presented for the purpose of contrasting it with Fig. 1, with reference to the use of risers and the necessity for feeding the casting. This casting is of the cylindrical type without flanges. However, in Fig. 1, risers *A* and *C* serve a two-fold purpose, namely, to rid the mold of the dirt, slag, etc., and they also serve to feed metal to the flanges. However, since risers *A* and *C* in Fig. 2 are not located over flanges, it is not essential that risers be used for feeding the mold. However, it is essential to provide these risers to insure clean metal throughout the casting. In pouring a mold of this kind the metal flows around the core and in rising undoubtedly carries with it a certain accumulation of dirt and, therefore, these end risers are essential.



FIGS. 3 AND 4—IMPROPER AND PROPER METHOD OF PLACING DIAGONAL RIBS ON CASTINGS

Those who favor the open riser contend that fins must be provided for the escape of air and gas under pressure from the mold and if no suitable exit is provided, scabbing will result. No two molds generate gases exactly alike, due to the variation in the moisture of the sand, temperature of the metal, etc. In pouring a dry sand mold, it is immaterial whether the risers be open or shut. The gases and steam generated in such a mold are nothing as compared with those generated in a mold of a green sand type. For this reason we always have left open the risers in dry sand molds. These provide ample means for the escape of steam, if any is generated, such as from daubing the joints with loam, etc.

For heavy green sand work we favor closed risers. A mold that is ready to receive metal contains air only, but immediately after the molten metal enters, gas is generated. When the mold is filled with gas, the additional gas generated compresses the gas which seeks exit through the vents and the top of the mold. It must be apparent that gas under pressure will sustain the whole interior of the mold, particularly the top which is liable to sag slightly. No such advantage may be gained from open risers as the gases then escape freely through the risers as rapidly as they are generated in the mold. Chaplets are used extensively in foundry work and when applied intelligently do no serious harm to the casting subjected either to steam or water pressure. However, the indiscriminate use of chaplets frequently results in casting losses and it is advisable to add metal at the point where it is necessary to locate chaplets. It is not advisable to place chaplets in any part of the mold if the csating is to be polished. However, this may be overcome by bedding in the studs below the surface of the mold. That part of the chaplet projecting from the face of the casting can be chipped off readily when cleaning and only a lighter metallic spot will be noticeable on the finished surface. Whenever possible, tinned chaplets should be used. It is essential, however, that they be coated with pure tin since a compound of spelter and tin is not nearly so desirable from the foundryman's standpoint. Also, the chaplets should be thoroughly coated,

and if this is not the case, they are liable to rust in storage and such oxidized surfaces will cause blowholes when in contact with molten metal. A casting rusted in this way should be dipped in creosote which will prevent blowing.

Probably no property of iron causes more trouble for foundrymen than that of shrinkage. It is generally assumed that shrinkage occurs in two stages. The first known as the internal, takes place between the time of filling the mold and the solidification of the metal. This causes draws, blowholes, etc. The second stage occupies the period between the complete solidification of the metal and atmospheric temperature. During this period warping, twisting and fracturing of the metal may occur.

The internal effects of shrinkage appear in the form of spongy, porous and weak spots in heavy castings. This effect is intensified at junctions, or where light and heavy sections join, since the cooling here is less rapid than in other parts of the casting. Therefore, the proper proportioning of the thickness of parts of the casting is an important factor in reducing shrinkage to the minimum. Sharp angles should be avoided wherever it is possible to do so. The warping or twisting of castings, due to unequal cooling, is not so much the cause of unequal distribution of the metal as the position of the casting while it is cooling. Some castings have a tendency to twist in cooling, but if turned, this might be overcome. If a U-shaped casting is made bottom-down, it is evident that the bottom side will remain hot longer than the legs of the casting and the legs invariably will be drawn in when cooling. However, if this casting is poured bottom-up, the bottom or heavy section will be exposed to the atmosphere and the legs of the casting will be exposed to the atmosphere and the legs of the casting will not be distorted, due to the more uniform cooling of all parts.

It is well-known that the internal structure of all metals, whether cast or forged, is influenced by the rate of cooling. The habit that some light work molders have of bearing-off castings at certain parts to insure uniformity of cooling, is not generally considered good practice. All such operations, regardless of how carefully they may be performed, are injurious to the casting by shortening or unduly hardening the grain of the metal. If a casting of comparatively uniform section is allowed to cool undisturbed in the flask in which it is poured, it will be found to be of a soft, machinable texture. Experienced molders know that factors to be considered in securing straight castings include the careful consideration of the size and location of gates and risers, position of casting, temper of the sand, etc. For example, if two long castings are poured side by side in one flask, one side of each casting will be warped. This is due to the fact that the two inside faces of the castings require longer to cool than the outside faces.

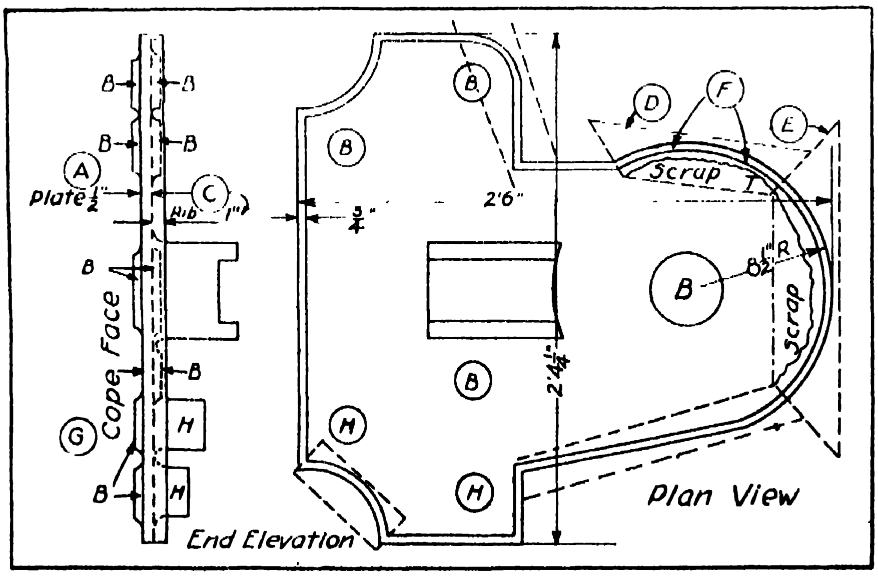
Fig. 3 illustrates a diagonal rib on a square casting. This is sure to result in a badly warped, unduly strained, if not in an actually broken casting. The placing of the ribs as shown in Fig. 4, will prove to be more satisfactory although the arrangements of these ribs in both Figs 3 and 4 are objectionable. However, in Fig 4, the strain is better distributed by the opposing action of shrinkage set up by the additional diagonal rib. While the ribs, as shown in Fig. 4, will have a tendency to balance the strain, a casting so designed cannot possibly have equality of shrinkage. In designing castings, it is essential that the parts be so proportioned that uniform shrinkage is assured.

Making a Pattern For an Oil Drip Pan

BY M. E. DUGGAN

IT IS said that there is a right way and a wrong way for doing everything. But the longer I remain at the trade the more I am inclined to believe that while there may be only one right way of making a pattern many wrong ones are also practiced. Two methods were employed in making two patterns similar to the one shown in the illustration. The first method is used by many patternmakers on work of a like character. It is long and round about and involves unnecessary time, labor and expense; the second method reduces the process to the essentials and is correspondingly economical. The illustration shows a pattern for a combination base and drip pan for a special machine. There is much more to the casting, but I am illustrating only the parts that are of interest in the making of the pattern. In the first method referred to, the stock for the plate A was passed through the planer and dressed down to ½ inch in thickness. The edges were jointed and boards, sufficiently wide, were glued together to make the plate. Then the plate was dressed by hand to the exact ½ inch in thickness, after which it was gone over with both coarse and fine sandpaper.

The operation of dressing the plate by hand was unnecessary, and applying sandpaper to an unfinished pattern is contrary to either good sense or good practice. The abrasive from the sandpaper imbeds itself in the wood and is detrimental to edge tools. The plate was next cut to the required shape. Stock for the rib around the edge was dressed to 1 inch, the required thickness. Each section of the rib was marked and sawed out separately and then fastened to the plate with glue and nails. The rib was then finished and draft-



PLAN AND END ELEVATION OF PATTERN FOR COMBINATION BASE AND DRIP PAN

out by hand with chisel and gouge. The bosses *B* were loosely fastened to the cope face of the pattern. This was unnecessary as they were very thin and had plenty of draft.

A short time after the first machine was placed in operation another one was built. It was designed like the first one but was larger. This necessitated a new pattern.

In making the second pattern the stock for the plate was run through the planer down to ½ inch in thickness, the edges jointed, and the boards glued together. The shape of the plate was laid out on this board. A plank was then dressed to 1 inch to provide stock for the ribs. Pieces as shown at *D* and *E* were cut from this plank to make a rib all around the pattern. These pieces were loosely fastened with wire nails to the side of the plate opposite to the side on which the marking was done. This is

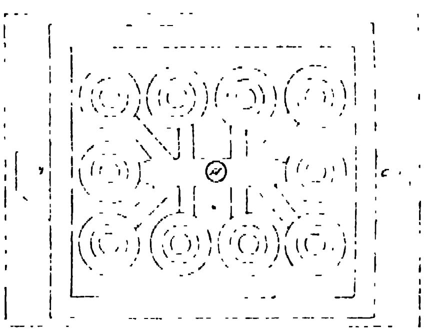


FIG. 1—PATTERN PLATE FOR MAKING O G CAST IRON WASHERS

quite contrary to general pattern shop practice but is really the best way to make plate patterns having ribs on edges. The plate with the short sections attached temporarily was then taken to the band saw. It was set on the table of the saw with the rib side down and cut to the outline all around. Brads were driven through the middle of the ribs and part way into the plate as indicated at *F* in piece *D*. Each piece was in turn treated this way. The location of the ribs was plainly marked on the top face of the stock

The width of the ribs, ¾ inch, was marked on both the ribs and the plate, before removing from the plate to prevent a possible mistake in the gaging or sawing. The ribs were then removed, with the wire nails left in them, and taken to the band saw where they were cut with an easy bevel to insure a good draw from the sand. Glue was applied to the joint face and the ribs returned and securely fastened in their places with wire nails. The pattern was then given a sandpaper finish, that is, after the pattern was made and not when it was half finished as is very often done by apprentices and journeymen young at the trade.

If apprentice boys were taught the short, practical ways of doing jobs, instead of the long round about ways which waste time and labor and so run up the expense, their services would be more appreciated and they would become better journeymen.

Making Cast Iron Washers in Quantity

By Pat Dwyer

Question.—We are interested in the manufacture of cast iron washers and would appreciate a detailed account of the most modern and economical way of making them

Answer. For the purpose of illustration we will assume that you are going to put one man on the job of making ¾-inch O. G cast-iron washers. You may then regard the following description as applying to a unit and fit up as many more as you please. A ¾-inch washer is 3 inches in diameter, therefore a 12 x 14-inch snap flask will accommodate 10 patterns.

The first step is to make a wooden pattern and cast 10 pieces from it either in white metal or aluminum. Of course you are not limited to the use of these two metals but they are the best in our judgment. Place the castings in a lathe and finish them true and smooth, taking particular care to see that the holes are true and nicely tapered. Then prepare a plate 14 x 16 inches, the same dimensions as the outside of the snap flask, with a lug at each end. See *B* and *C* in accompanying illustration, Fig. 1. Lay the part of the snap containing the guide holes on the plate and mark through them. Drill holes at these places and finish them carefully to the triangular shape of the guides. This is an important point; the holes must be loose enough to slip up and down on the guides easily, but there must be no lateral play. Just a nice loose sliding fit.

Having finished the guide holes, lay the plate on the bench, scribe a center line on it and arrange the patterns to the best advantage on both sides of the line. In this case the patterns will be 1 inch away from the sides of the flask, ½-inch away from the ends and about ¼-inch from each other.

Take the plate and patterns to a drill and drill two ¼-inch holes right through each pattern and plate. Mark each pattern individually so it can be located again. Tap the holes and screw the patterns firmly to the plate; or you may countersink the holes and rivet the patterns in their places.

The pattern plate may be aluminum or white metal ½-inch thick, or it may be a piece of ¼-inch steel plate; in either case it must be flat and straight.

A wooden pattern for a gate is then prepared. It is carefully fitted so that it touches each of the patterns. The main branch is 1¼ inches wide by ¾-inch thick and branches are ¾-inch wide by ½-inch thick. A casting is made off this pattern either in white metal or brass and after it is finished nice and smooth it is fitted into place on the plate and screwed or riveted into place in the same manner as the patterns. Before attaching the gate to the plate a ⅞-inch hole is drilled through it as shown at *A* in the accompanying illustration, the purpose of which will be referred to later.

In order to make molds with this pattern, the molder lays the plate on the table of his machine, pattern side up, and sets on that part of the flask

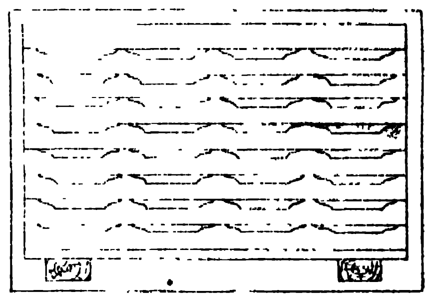


FIG. 2—MOLDS STACKED FOR POURING. THE BOTTOM FACE OF EACH DRAG SERVES AS A COPE FOR THE PRECEDING MOLD

containing the pins or guides. He then drops in a thin iron band which hugs the inside of the flask closely. The purpose of this band is to prevent the mold from bursting during the operation of pouring the iron. He riddles in some sand, presses the sand in the holes in the patterns with his index finger, then fills the flask with sand and squeezes it. The sequence of operations then are: He puts on his bottom board (this only applies to the first one), rolls the mold over, raps the pattern plate and lifts it off, carries the mold to the front of his floor, removes the snap, carries it back to his machine and starts another one.

In the second and succeeding ones a short gate pin is set up in the recess previously referred to in the horizontal gate. This leaves an opening through each body of sand and forms a continuous upright gate from top to bottom.

As may be seen by referring to the sketch, Fig. 2, there are, properly speaking, no copes used, the bottom face of each drag acting as a cover for the preceding mold.

If you do not care to fit up the patterns yourself, any of the molding machine makers will supply you.

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Contents

Evolution in Casting Plants

ONE outstanding feature has characterized the many casting manufacturing plants which have been constructed during the year just past. The modern foundry as represented by the many built in 1919 is a thoroughly efficient factory building, erected and equipped with the idea of adaptability paramount. In times gone by, any sort of second hand structure has been deemed satisfactory for a foundry. The only requirements in foundries of the past century were a roof, some sections of side walls and a floor; anything in fact which would surround and partially house some sand heaps, a few flasks and melting equipment. All routing of work was fitted to the existing structure irrespective of all questions of efficiency. This of course does not represent all the older foundries. However, the exception serves only to prove the rule. The entire basis of plant design was revised and the building was made a part of and tributary to the general manufacturing scheme during the tremendous building period of 1919. Considerations of efficiency governed the layout of buildings. Human conservation, health and comfort ruled in the design of heating, lighting and ventilating features in more recent establishments. Sound engineering principles formed the groundwork both for the buildings and equipment. This great stride in foundry construction has not been the result of an immediate change. It has been a development of many years, but has been more strongly apparent in the many structures erected recently. The free interchange of ideas fostered by technical and commercial organizations has aided greatly in bringing better principles of plant design to the foundry industry.

Attention to Costs

WHEN work is scarce, labor is plentiful and materials are cheap, the castings manufacturer scans every inquiry carefully. He figures his costs closely with a watchful attention. He competes for every job with others confronted by similar problems of keeping their plants engaged to carry overhead and interest changes. Foundrymen have known such times within the past few and many have made a careful study of the cost problem under pressure of slack times. With the start of 1920 conditions are changed. Work is plentiful while both material and labor are scarce and high. With few exceptions, most commercial foundries find an abundance of inquiries from customers who appreciate the general conditions and are willing to pay higher prices. Expansion is the order of the day. Now as never before is the need for an adequate foundry cost system imperative. Any system which is not sufficiently elastic to permit each estimate to care for constantly advancing prices should be discarded. All fixed percentages, added to care for overhead, depreciation and interest, should be revamped so that each job may carry its fair proportion of the rising prices. Past production figures which are used as a basis for present estimates should be scrutinized and checked. The foundryman who today makes costs his study is best equipped to meet any possible reaction which may follow the unprecedented expansion of the present day.

DATA ON CHIMNEY DESIGN

By J. G. Mingle

Correction for Velocity Losses

The theoretical intensity of draft is correct only when there is no flow or circulation. When the gases are flowing, the theoretical value is decreased by the losses due to velocity and friction within the chimney. This difference is called the available draft.

$$D' = KH - (h_v + h_f)$$

where D' = available draft in inches of water,

h_f = loss due to friction in inches of water,

h_v = loss due to velocity in inches of water.

The loss of draft due to velocity within the chimney is determined by the formula

$$h_v = 0.1184 \frac{V^2}{T_c}$$

where V = mean velocity of chimney gases in feet per second.

Fig. 2 gives the values of h_v for various chimney gas temperatures with the different mean velocities as shown.

(*Continued on Data Sheet No. 318*)

DATA ON CHIMNEY DESIGN

By J. G. Mingle

(*Continued from Data Sheet No. 317*)

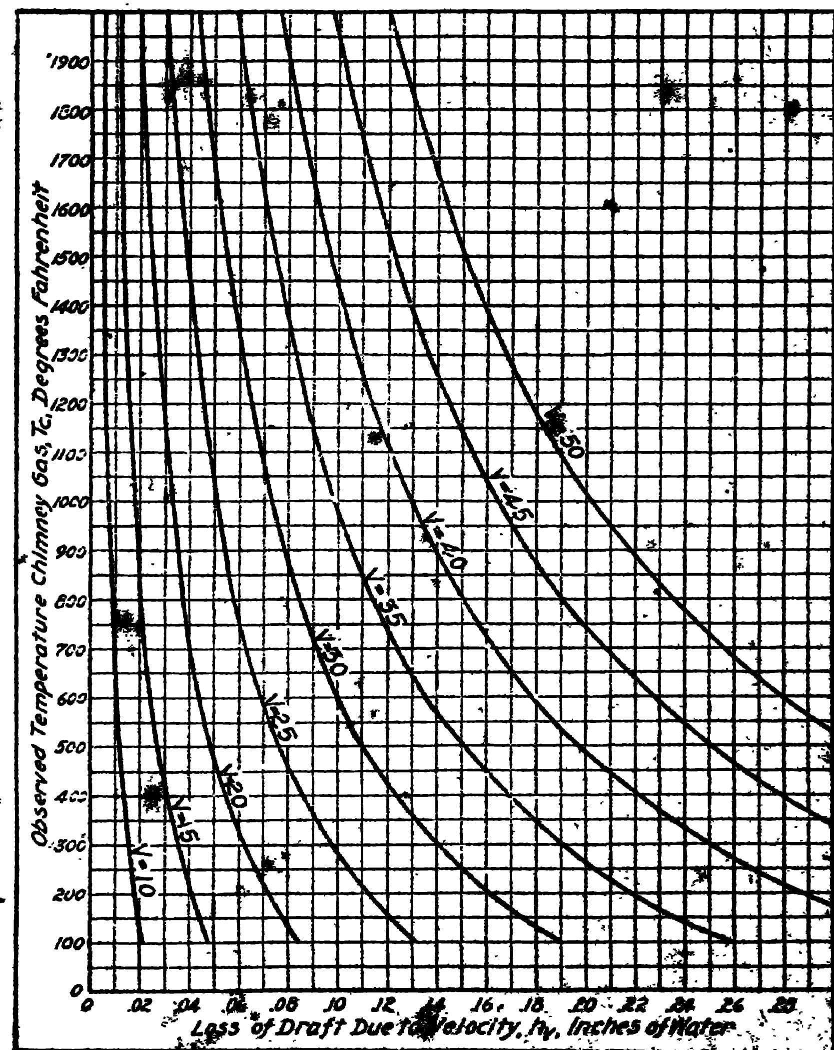

FIG. 2—CURVES GIVING LOSS OF DRAFT DUE TO VELOCITY

Trade Outlook in the Foundry Industry

SHORTAGE and delayed delivery of needed pig iron still continue to cause concern to many foundries. Coke scarcity, due largely to car shortage, is affecting the supply of iron, particularly high silicon grades. A noticeable slackening in demand for iron has taken effect during the past two weeks, due partially to the general knowledge that little first half iron is available and the lingering hope that the present high prices may be lowered for the last six months of the year. Producers are offering little iron at the present time, and indicate a desire to await developments and to estimate their last half costs.

Production Increases

December showed a marked increase in pig iron production, despite the hampering effect of the coal strike which prevailed during several weeks. Although the gain is not as large as that attained in November, and some credit is due to the 31 day month, the tendency toward greater production to meet the unprecedented demand is marked. The total production of all classes of pig iron for December, as reported by The Iron Trade Review, was 2,629,850 tons, an increase of 222,481 tons over the November total. The average daily production for December was 84,334 tons per day, a gain of 4590 tons per day over the preceding month. The effect of fuel restriction, however, is clearly indicated by the ratios of increases. November showed a gain of 32 per cent over the preceding month, while December made only 5.72 per cent advance. The total iron production for 1919 is considerably lower than the two preceding years. This may be attributed in part to the slack demand during the early portion of the year and in part to disturbed industrial conditions during the closing months. Merchant iron production for December was 686,950 tons, an increase of 61,025 tons over the month of November. This was a net gain of 1295 tons per day or 6.2 per cent over the preceding month.

Railways Will Buy

With the date set for the return of the railways to private ownership, hope is renewed for an early buying movement on all classes of equipment. This in turn would induce a strong demand for various grades of castings. The Railway Age estimates that it will require more than three years to bring the rolling stock and equipment of the railroads up to standard again. This is attributed to the small amount of railway buying under government ownership, the pyramided needs for replacements and the extensions which are needed at this time. The estimate presented for the requirements of the next three years includes some 24,500 passenger cars, 712,400 freight cars, and 13,840 locomotives in addition to track, terminal, shop and station construction with the attendant demand for tools and equipment. Malleable and steel shops will benefit largely by a real railway buying movement. The former at the present time are operating at 85 per cent of capacity. Those malleable plants which handle both railway and miscellaneous work are filled with orders for castings other than those required by railways. Malleable shops which make railway castings exclusively are fairly busy upon replacements and urgent repairs.

Shops are Busy

The peak of demand for all classes of castings was not attained during 1919. Starting in the late spring, foundry orders have increased in volume steadily, the acceleration being more marked in gray iron and malleable than was noted in steel and nonferrous lines. No signs of slackening have appeared. Automobile production schedules for trucks, passenger cars and tractors are larger than ever before. Automobile castings are being sought in sections far remote from the assembly plants. Stove and furnace manufacturers still are behind on last year's deliveries. Eastern and southern cast iron pipe makers are unable to make deliveries even during these off months of the year, short of 60 days, and in some cases 90 days or longer are asked. Machine tool builders continue to require a great number of castings to keep up with production schedules. Engines for factory power plant use are strongly in demand. Some engine and special machinery builders in the gulf states are inquiring for castings as far north as Birmingham, Ala. and St. Louis. In the central west and some sections of the east, labor shortage continues to hamper production in many foundries. With the tremendous demand and mounting prices on labor and materials, prices have advanced on practically all classes of castings. The average price for gray iron castings in the Chicago district ranges from $90 to $100 per ton with scaled advances for lighter and more complicated work. In almost every instance, price is made a secondary consideration and the specified time of delivery is a basis upon which castings are bought and sold. Steel foundries still are slower to reach the peak of production attained by other branches of the industry.

Nonferrous prices based on New York are as follows: Copper, 18.87½c to 19.00c; lead, 8.75c to 9.00c; tin, 63.25c; antimony, 10.00c to 10.25c; aluminum, No. 12 alloy, producers price, 31.50c, open market, 30.00c to 30.50c. Zinc is quoted at 9.25c to 9.37½c, St. Louis.

Prices of Raw Materials for Foundry Use

CORRECTED TO JAN. 7

Iron	
No. 2 Foundry Valley	$38.00
No. 2 Southern, Birmingham	30.00 to 40.00
No. 2 Foundry, Chicago	40.00
No. 2 Foundry, Philadelphia	42.10 to 43.25
Basic, Valley	37.00
Malleable, Chicago	40.50
Malleable, Buffalo	41.25

Coke	
Connellsville foundry coke	$7.00
Wise county foundry coke	8.25

Scrap	
Heavy melting steel, Valley	$24.00 to 24.50
Heavy melting steel, Pittsburgh	25.00 to 26.00
Heavy melting steel, Chicago	24.75 to 25.00
Stove plate, Chicago	33.00 to 33.50
No. 1 cast, Chicago	42.00 to 42.50
No. 1 cast, Philadelphia	33.35
No. 1 cast, Birmingham	26.00 to 27.00
Car wheels, iron, Pittsburgh	32.00 to 33.00
Car wheels, iron, Chicago	34.50 to 35.00
Railroad malleable, Chicago	31.50 to 32.50
Agricultural malleable, Chicago	33.00 to 33.50

Comings and Goings of Foundrymen

J. P. PERO, who for the past 11 years has been general superintendent and sales manager of the Missouri Malleable Iron Co., East St. Louis, Ill., has retired after 50 years' continuous service in the foundry industry. He will continue to devote a portion of his time to interests which he maintains in various foundry and manufacturing industries in St. Louis. Mr. Pero, who was born in Waltham, Mass., Dec. 9, 1856, belongs to a family which has been prominent in the foundry business of New England for three generations. He was educated in the public schools of Waltham and Worcester, Mass., leaving the Worcester high school in his junior year to become an apprentice molder. This was in February, 1870, when he was only 13 years old. During the following years, until he was made foreman in 1882, Mr. Pero studied the art of molding, specializing in heavy work. Following his first foremanship, he was identified with the management of some of the leading New England and Mississippi valley foundries. His first 30 years in the industry covered gray iron work, while during the past 20 years he has been identified with malleable plants. In 1887, Mr. Pero conceived the idea of an association of foundrymen having for its purpose the exchange of views on technical and practical problems of foundry work. In December of that year he formed the New England Foundrymen's association, which was the original society devoted to educational work among foundrymen in this country. Mr. Pero long has been active in the work of the American Foundrymen's association. He was president of that body in 1916-1917, and has been a director continuously for a number of years.

S. Stoneham, formerly associated with the Union Steel Castings Co., Roxbury, Mass., and before that with the Ohio Steel Castings Co., Springfield, O., has taken the position of superintendent with the Hub Electric Steel Casting Co., South Boston.

Charles F. Hutchins of Worcester, Mass., treasurer of the Standard Foundry Co., of that city, has been appointed a director of the New Finance Corp. of New England, Boston, which recently was incorporated with a capital stock of $1,000,000.

George C. Beebe has been appointed manager of the Cleveland branch of the Columbia Tool Steel Co., Chicago Heights, Ill., in place of E. D. Clarage, who has resigned.

C. R. Pieper has been made general manager of the Iron Products Corp., La Crosse, Wis., which company plans to construct a new plant.

Alphons L. Orschell has resigned as brass foundry superintendent of the Lunkenheimer Co., Cincinnati, and is now associated with the Hill & Griffith Co., of the same city.

James B. Leggett, instructor in foundry practice at Leland Stanford university,

J. P. PERO

Palo Alto, Cal., is making an inspection tour of eastern and middle western states to study foundry practice, particularly in automobile plants.

Herbert J. Roe, works manager of the Adaptable Molding Machine Co., Birmingham, England, returned home recently after spending three months subsequent to the American Foundrymen's association convention in inspecting American industrial plants.

Lawrence M. Brile who has been connected with the United Smelting & Aluminum Co., Inc., New Haven, Conn., as vice president and sales manager for the past five years, severed his connection with that company on Jan. 1 to assume the presidency of Brile & Ratnor, Inc., a New York corporation formed to engage in the metal and chemical brokerage business. Mr. Brile has charge of the nonferrous end of the business, and Mr. Ratnor, one of the best known men in the chemical industry has charge of the chemical department. The office of Brile & Ratnor, Inc., is located temporarily at 115 Broadway, New York.

John L. Nute formerly connected with the Kenneth Fdy. & Mach. Co., Kenneth Square, Pa., is now associated with A. J. McGhee and H. J. Gulden under the firm name of Nute-McGhee-Gulden Co. The company has purchased the entire foundry equipment of the Calvin Gilbert Foundry of Gettysburg, Pa., and has installed it in a building in Chambersburg, Pa., with the object of carrying on a general jobbing foundry business in gray iron, brass, bronze and aluminum.

W. S. Robinson, superintendent of the Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., has been made general superintendent of that company, the Chicago Stove & Range Co., Benton Harbor, and the Muncie Malleable Foundry Co., Muncie, Ind., which now are associated industries. The Muncie foundry until recently was the Whiteley Malleable Casting Co. Oscar Allerton, formerly assistant superintendent of the Benton Harbor Malleable Foundry Co., now is superintendent of the Chicago Stove & Range Co., and his former position will be filled by Herman Crittner. John Moloski, formerly assistant manager of the Benton Harbor plant, has been made manager of the Muncie foundry, and he in turn is succeeded by F. A. Fuller.

P. J. Flaherty recently was elected president of the Johnson Bronze Co., New Castle, Pa., to fill the vacancy created by the death of G. W. Johnson. This company is successor to the American Car & Ship Hardware Co. which was taken over in 1919 and reorganized. Prior to that time the products manufactured in the plant were steam and electric car fittings. After the reorganization this line of manufacture was abandoned and the plant equipped for the production of automobile bronze parts, especially bushings. This entailed the rebuilding of the plant, the scrapping of the old machinery, and the purchasing of proper equipment. At the present time the company is one of the largest manufacturers of bronze bushings in the country.

Testing Society to Meet in Asbury Park

The annual meeting of the American Society for Testing Materials will be held at the New Monterey hotel, Asbury Park, N. J., during the week of June 21. This is a marked departure from the precedent of long standing of holding the conventions of this society at Atlantic City.

The growth of this organization during the past year is indicated by the election of 401 new members, compared with 303 for 1918, and 362 in 1915, which represented the greatest accession in membership during a 12-month period until the record established last year. The net growth in membership was 249, making the present total membership 2572.

Acquires East St. Louis Malleable Plant

The National Malleable Castings Co. has added another property to its manufacturing facilities in the purchase of the plant of the Missouri Malleable Iron Co., one of the oldest industries of East St. Louis, Ill. The East St. Louis plant has an annual capacity of about 20,000 tons of malleable products. Possession of the new property was assumed on Jan. 2, 1920. F. E. Nulsen, president of the Missouri Malleable Iron Co., is retiring from business and his son, John C. Nulsen, will be manager of the East St. Louis plant. E. W. Felger will fill the position of local treasurer. Acquisition of this plant gives the National company seven malleable iron casting plants, located at Cleveland. Chicago, Indianapolis. Toledo and East St. Louis. It also has steel castings plants located at Sharon, Pa., and Melrose Park, Ill.

Grinnel Co. Inc. Assumes Extinguisher Lines

All of the sales and contracting business formerly carried on by the General Fire Extinguisher Co. was taken over by the Grinnell Co., Inc., on Jan 1, 1920 The change was made because the old name so specifically described the automatic fire protection section of the company's business that it did not cover the company's several closely related lines of business including fire protection, power and process piping, steam, hot water and gas heating, drying, and sales of pipe, valves and fittings.

British Products Shown in Brazil

The great extent to which American manufacturers and exporters of iron and steel, engineering materials and hardware have taken advantage of the opportunities afforded them in Brazil by the war may be judged by the Brazilian trade returns. These reports show that although German competition has been practically destroyed, British manufacturers are now faced with still more serious competition from one of the most highly developed manufacturing countries in the world. The seriousness of the situation has roused the officers and members of the British chamber of commerce of San Paolo and southern Brazil to closely study and initiate means for outstripping their competitors. With the object of influencing Brazilian importers to purchase British goods arrangements have been made to hold a series of British industrial exhibitions in the city of Sao Paolo which is the heart of the great manufacturing district of Brazil and, indeed, of South America. The first of these exhibitions, extending from Dec. 1, 1919, to Feb 28, 1920, comprised small hardware goods and other lines allied to the hardware trade.

Starts Construction of New Building

The Buckeye Tractor Ditcher Co., Findlay, O., has started the foundation for a new foundry building, 100 x 220 feet. The building will be of brick and steel construction and will be modernly equipped with electric traveling cranes, molding machines and other facilities for handling work to advantage. It is the intention of the company to make all its own gray iron, electric steel and brass castings in the new shop.

The Kenney Foundry & Mfg. Co. plant, Mansfield, O., was destroyed by fire on Jan. 1. The company is seeking a location nearby to resume operations at the earliest possible date.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Automotive Tractor Co., Frederick, Md., contemplates the erection of a plant, 50 x 200 feet

The plant of the Grand Haven Brass Foundry, Grand Haven, Mich, recently was damaged by fire.

The Reliable Stove Co., Cleveland, is said to be planning the erection of a plant, 60 x 120 feet.

Alterations to its plant are being planned by the Estate Stove Co, Hamilton, O.

Erection of an addition to its foundry is contemplated by the Superior Iron Works, Superior, Wis.

The plant of the Atlantic Foundry Co., near Cuyahoga Falls, O., which was recently damaged by fire, will be rebuilt.

The National Cash Register Co., Dayton, O., is reported to have had plans prepared for the erection of a foundry, 165 x 500 feet.

Erection of a pattern shop, 1-story, 58 x 168 feet, is contemplated by the Toledo Machine & Tool Co., Toledo, O.

Erection of a plant, 55 x 160 feet, is reported to be contemplated by the New Process Stove Co., Cleveland.

The erection of plant extensions are reported to be planned by the Zanesville Malleable Co., Zanesville, O.

The General Engineering Co., Alpena, Mich., John Lundberg, president, contemplates the erection of a foundry and machine shop, 70 x 80 feet.

The capital stock of the Flint Foundry Co., Flint, Mich, recently was increased from $50,000 to $100,000.

Capitalized at $40,000, the Glenwood Foundry, Philadelphia recently was incorporated by W. R. Nicholson Jr. and others.

A site on which it plans the erection of a modern plant has been purchased by the American Range Foundry Co., St. Louis.

The capital stock of the Johnson City Foundry & Machine Co., Johnson City, Tenn., recently was increased from $10,000 to $100,000.

Erection of a 90 x 100-foot addition to its plant is contemplated by the Baltimore Car Foundry Co., Baltimore

The capital stock of the Hercules Gas Engine Co., Evansville, Ind, recently was increased from $250,000 to $500,000.

The Imlay City Foundry Co, Imlay City, Mich., recently was organized with $25,000 capital, by P. W. Mulder and others.

Plans have been drawn for the erection of a foundry, 90 x 110 feet, for S. E. Shaecht, 1700 Prairie avenue, Elkhart, Ind.

The W. W. Sly Mfg. Co., 4700 Train avenue, Cleveland, contemplates the erection of a storage building, to be 1-story, 50 x 65 feet.

The Erie Foundry Co., Erie, Pa., has had plans prepared for the erection of a plant, to be 81 x 204 feet.

The W. J. Westbrook Elevator Co., Greensboro, N. C., is reported to be planning the erection of a foundry.

Capitalized at $25,000, the Reedsport Iron Works, Reedsport, Oreg., has been incorporated to engage

in iron working, machine shop and foundry practice, by Arthur J. Bews, Winnie Bews and D. A. Smith

The Miami Brass Foundry and the Miami Mfg. Co., Dayton, O., each headed by Ben Semmelman, will erect a plant.

Plans have been completed for the erection of a building of frame construction for the Specialty Foundry Co., Portland, Oreg.

The Frost Mfg. Co., Kenosha, Wis., has increased its capital from $200,000 to $400,000 and will erect additions to its foundry and machine shop.

Work has started on the erection of a plant for the Engman-Matthews Range Co., Goshen, Ind. The building will be 80 x 1000 feet.

The George J. Meyer Mfg. Co., 576-598 Clinton street, Milwaukee, is considering plans for extensive enlargement of its foundry and machine shop.

Foundries, Ltd., Ottawa, Ont., has been incorporated with $24,000 capital, by Frederick Menagh, Harold E. Morrani, Alfred Blake and others.

Fire damaged the main building and the east wing of the plant of the Hope Foundry Co., Auburn, R. I., manufacturer of gray iron castings.

The plant of the Freeland Foundry & Machine Co., Freeland, Pa., recently damaged by fire, will be rebuilt.

The Universal Winding Co., Auburn, R. I., has started work on the erection of two additions to its foundry.

The McInnerney Co., Council Bluffs, Iowa, recently was incorporated with $250,000 capital to operate a general machine shop and foundry, by B. McInnerney, E. A. Wickham, E. H. Lougee and others.

The Advance Pump & Compressor Co., Battle Creek, Mich., is erecting a foundry, machine shop, power house, testing room, blacksmith shop and warehouse, which will double its capacity.

A plant, 60 x 200 feet, will be erected by the Regle Brass Co., Greenville, Mich., which was recently incorporated with $100,000 capital. J. B. Couture is president and general manager.

The C. & G. Pattern Works, Indianapolis, recently was incorporated with $10,000 capital, by F. D. Crider, Charles J. Gisler and A. H. Gisler, to manufacture iron patterns.

Construction of a foundry unit, 60 x 100 feet, has been started on a site of seven acres, recently purchased by the J. C. Green Foundry Co., Vassar, Mich. J. C. Green is president.

Architects Dowitz & Webb, 232 St. Paul street, Baltimore, is preparing plans for the erection of a foundry and machine shop, 60 x 300 feet. The name of the owner is withheld.

The Mascot Stove Mfg. Co., Chattanooga, Tenn., has leased a plant and will remodel it for the manufacture of ranges. The capacity of the plant will be trebled

The Bowen Foundry, Machine & Electrical Co., Harlan, Ky., recently was incorporated with $20,000 capital, by C. D Bengey, C. H. Winfrey and M. L. Bowen.

The Boircourt Machine Co., Ft. Worth, Tex., which was recently incorporated with $30,000 capital, is reported to be planning the erection of a gray iron and brass foundry.

Capitalized at $500,000, the Rail Welding & Foundry Co., Wilmington, Del., recently was incorporated by T. L. Croteau, H. E. Knox and S. E. Dill.

Capitalized at $30,000, the Mid-West Foundry Co., Marion, Ind., recently was incorporated to engage in a general foundry business, by Otto Brunka, Fred Brunka and A. Williams.

The Ozaukee Heater Co., Saukville, Wis., manufacturer of oil-burning heating devices, will erect a gray-iron foundry, by making an addition to its present machine shop.

The Charles H. Stehling Co., 401 Fourth street, Milwaukee, has purchased the gray-iron foundry at Cedarburg, Wis., from the Western Rope & Mfg. Co. of Oklahoma.

R. Nelson Molt, Millbury, Mass., Samuel Seder and Samuel G. Nash, recently were named as the incorporators of the Vulcan Foundry Co., Worcester, Mass., which was chartered with $10,000 capital.

Capitalized at $10,000, the Hammond Malleable Iron Co., Hammond, Ind., recently was incorporated by H. J. Wanner, H. C. Wanner and B. J. Steelman.

The plant of the Birmingham Machine & Foundry Co., Birmingham, Ala., recently was damaged by fire.

Bennett & Seeley, Inc., Bridgeport, Conn., has been incorporated with $50,000 capital, by F. A. Bennett, E. E. Seeley, New Haven, Conn., and F. E. Morgan, to deal in mill and foundry supplies.

The Merrimac Valley Iron Foundry Co., Amesbury, Mass., recently was incorporated with $3000 capital, by Louis Caouette, Fred Gonthier, Newburyport, Mass., and Arthur Cromier.

Announcement has been made to the effect that the Reading Iron Co., Reading, Pa., has purchased the plant of the E. & G. Brooke Iron Co., at Birdsboro, Pa.

The Dunham Co., Berea, O., has leased the foundry of the Hasting Iron & Foundry Works, Hastings, Mich., and will organize it for the manufacture of land rollers, auto parts, etc.

Capitalized at $150,000, the New England Brass Foundry Co., Worcester, Mass., recently was incorporated as a subsidiary of the Coppus Engineering & Equipment Co., by H. C. Coppus, Otto Wechberg and Linwood M. Erskine.

Capitalized at $200,000, the Erie Stove & Mfg. Co., of Canada, Ltd., Montreal, Que., recently was incorporated to manufacture heating appliances, etc., by Frank B. Common, Francis Bush, Herbert W. Jackson and others.

The Meadows Mfg. Co., Bloomington, Ill., has completed the erection of the first one of a group of factory buildings. This structure is a foundry building, 90 x 260 feet. The next unit to be erected will be used for a core room and pattern shop.

The gray-iron foundry of the former Janesville Machine Co. at Janesville, Wis., now a part of the Samson Tractor Co., will be enlarged by the erection of an addition, 120 x 180 feet. The present foundry and machine shops are being remodeled.

Architects are at work on plans for the erection of an addition to the plant of the E. H. Bardes Range & Foundry Co., Cincinnati. The addition will be 85 x 102 feet, and will be used as a core room and pattern shop.

In order to increase its production, the Cabco Iron Works, Inc., Diamond Bank building, Pittsburgh, recently increased its capital. At present the company is not in a position to announce its plans for increased output.

Plans have been prepared for the erection of a foundry, 170 x 700 feet, for the Lycoming Foundry & Machine Co., Williamsport, Pa. When completed it will be devoted to the production of automobile engine castings. J. H. McCormick is general manager.

Plans have been completed for the organization of the Franklin Die Casting Corp., Syracuse, N. Y., with a capital of $1,000,000. Howard L. Franklin is to be president, H. C. Skinner, vice president, and C. E. Hull, secretary and treasurer. The company will erect a plant.

The Jorgenson Mfg. Co., Waupaca, Wis., maker of brass specialties and gas engine parts, has increased its capital from $70,000 to $350,000 and will spend about half of the new issue for buildings and machinery. P. J. Jorgenson is president and general manager.

The Production Foundries Co., Ann Arbor, Mich., recently increased its capital from $100,000 to $200,000, in order to permit the payment of bonded indebtedness and to provide funds for additions to its plant. Enlargement of the works will not be started until spring, and will consist chiefly of an addition to the molding floor.

The Pullman Co., Chicago, is making extensive improvements to its establishment. These improvements comprise the erection of a 3-story building of approximately 293,000 square feet of floor space, a press building, 80 x 200 feet and the remodeling of the Union Foundry buildings, providing approximately 190,000 square feet of floor space.

The Racine Confectioners' Machinery Co., Racine, Wis., plans to erect a 2-story building, 50 x 165 feet and an adjoining structure, one story, 40 x 145 feet. No new equipment for these buildings will be needed other than a traveling crane for the 1-story unit, which will have about a 36-foot span. Construction will start as soon as the weather permits.

The Flint Pattern & Foundry Co., 519 Bush street, Flint, Mich., has plans for the erection of a plant, 40 x 100 feet, part two stories. The first floor will be used as a foundry, which will be equipped with four furnaces of gas or oil type, two coke fired furnaces, molding machines, etc. The upper portion of the building will be devoted to the manufacture of bronze bushings.

The National Malleable Castings Co., Cleveland, has added another property to its rapidly-extending chain of foundries, in the purchase of the plant of the Missouri Malleable Iron Co., East St. Louis, Ill., which has an annual capacity of 20,000 tons of malleable-iron castings. Acquisition of this plant gives the National Malleable Castings Co. five malleable-iron foundries, located at different cities throughout the country.

Announcement of the organization of the Automotive Foundry Co., at LaCrosse, Wis., has been made, and the company has purchased a site on which it plans to erect a plant, 100 x 220 feet, contract for which has been let. The concern will specialize in the manufacture of motor pans, cylinder heads and other auto engine parts, and high-grade casting work. The company is capitalized at $100,000, and O. B. Dibble is one of the officers.

A partnership formerly composed of S. K. DeHart, R. H. Chilton and H. L. Beaty, Nashville, Tenn., has been discontinued and a company formed to take over the plant and be known as the DeHart & Chilton Machine & Foundry Co. The company will operate an iron foundry, a brass foundry and blacksmith and machine shops. The company is capitalized at $50,000 and the incorporators are S. K. DeHart, Katherine DeHart, I. M. DeHart, B. B. Cranch and H. L. Beatty. The company will probably be in need of equipment, but at this time is unable to state its requirements.

New Trade Publications

LIFT TRUCKS.—A 4-page folder is being circulated by the Barrett-Cravens Co., Chicago, in which the use of lift-trucks in the core room is described. The folder is entitled, "Scientific Methods in the Core Room."

BOLTS.—The Columbus Bolt Works Co., Columbus, O., has published a large catalog in which bolts, nuts, carriage and automobile forgings are described and illustrated. Complete specifications are given. One section of the booklet contains some interesting data and tables.

VALVES.—A cloth-bound 156-page catalog, has been published by the Nelson Valve Co., Philadelphia, in which bronze, iron and steel valves, gate, globe, check and nonreturn valves are described and illustrated, and specifications, etc., given. The various valves are illustrated.

WOODWORKERS' VISE.—An illustrated folder is being circulated by the Oliver Machinery Co., Grand Rapids, Mich., in which a woodworking vise is described and illustrated. This vise, according to the folder, can be adjusted easily and speedily to any desired angle by a large hand operated collar and is clamped into any tilted position by a rack bar. All parts are interchangeable. The folder also states that the vise may be set at any point in a 90 degree arc and be rotated and set at any point desired within the complete arc of another circle at right angles with the former, without loosening the work in the jaws.

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Piston Rings Cast Centrifugally

Molds Are Made in Round Cast Iron Flasks With Layers of Cores—The Castings Are Entirely Surrounded With Sand—Centrifugal Pressure Produces Iron of Dense Structure

BY H. E. DILLER

CHANGES in composition and physical properties through manipulation in the melting furnace and subsequent heat treatment have given a great impetus to the metallurgy of steel. Different melting mediums such as the bessemer converter, the crucible furnace, the open-hearth and the electric furnace, have played important roles in the drama of better steel. However, the metallurgy of gray iron has lagged behind. The cupola still is by far the most commonly used melting medium for gray-iron, although for many years the air furnace has been employed to a limited extent, and recently the electric furnace has found favor in a few exceptional cases.

This notable difference in the development of melting mediums, heat treatment and metallurgy of the two principal ferrous products may be accounted for primarily by the influence of carbon in the two metals. The small portion of carbon in steel can be changed into pearlite or cementite and mixed in the steel with ferrite in various proportions to control the strength and ductility of the metal, while in gray iron a variation in the total carbon content does not make the marked difference in strength that it does in steel. This is due to the large amount of either graphite or of combined carbon which must be present in gray iron. If the total carbon is reduced too low in gray iron the advantage of ease in handling to a great extent is lost. On the other hand, if the total carbon is maintained around the normal amount found in cupola metal there is either 3.25 per cent graphite or that much combined carbon, or a mixture of the two in any proportion totaling about 3.25 per cent. This precludes heat treatment of gray iron with the exception of annealing. The heat treatment of quenching and drawing so frequently applied to steel, is impossible with gray iron on account of the high carbon content.

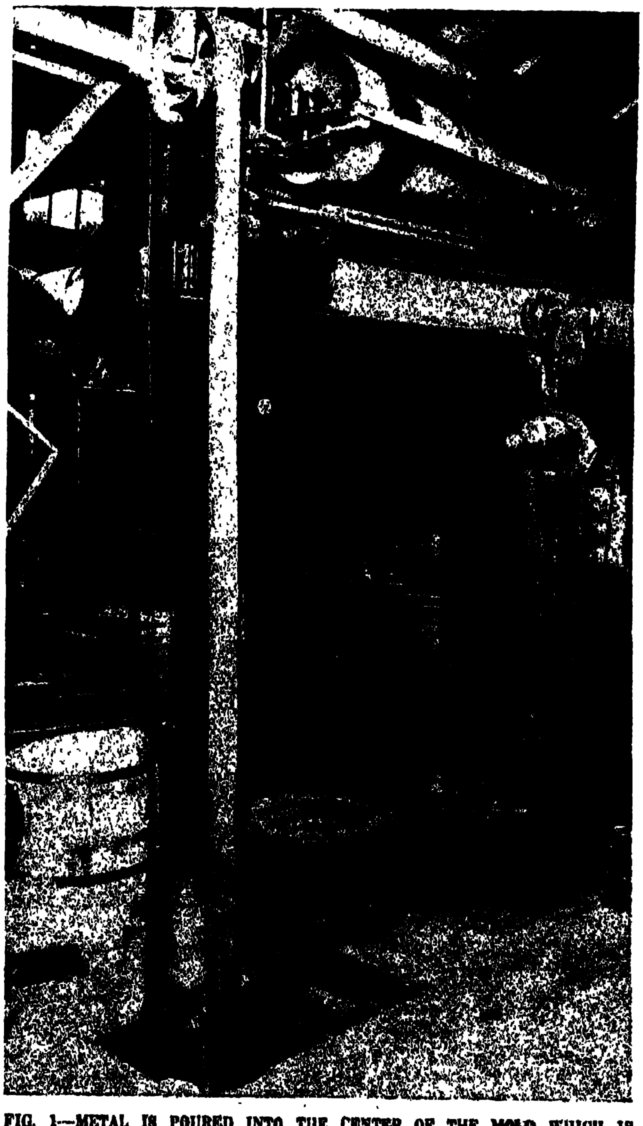


FIG. 1—METAL IS POURED INTO THE CENTER OF THE MOLD WHICH IS THEN REVOLVED AT A RATE WHICH PRODUCES A CENTRIFUGAL PRESSURE OF APPROXIMATELY 100 POUNDS PER SQUARE INCH

However, advancement recently has been made in the metallurgical treatment of gray iron brought about through experiment and a study of the properties of the metal and its action under different conditions. Experiments made by the Wasson Piston Ring Co., Plainfield, N. J., under direction of John A. Rathbone, foundry manager, have developed some important facts in the metallurgy of gray iron and also evolved a method of casting piston rings by the centrifugal process. Mr. Rathbone now

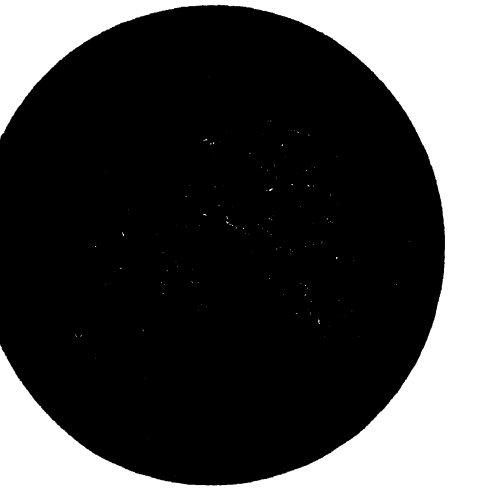


FIG. 2—AT THE LEFT—MICROGRAPH OF CHILL CAST METAL SHOWING THAT MOST OF THE CARBON IS COMBINED, BUT THERE ARE OCCASIONAL SPOTS OF FREE CARBON AS ILLUSTRATED IN THE UPPER RIGHT-HAND CORNER
FIG 3—AT THE RIGHT—AFTER THE CHILLED IRON WAS HEATED FOR A MINUTE OR TWO AT NEAR 2000 DEGREES FAHR. A LARGE PORTION OF THE COMBINED CARBON SEPARATED OUT AS TEMPER CARBON—THE UNETCHED MICROGRAPH RESEMBLES A MICROGRAPH OF MALLEABLE IRON

is with the H. M. Lane Co., Detroit.

Formerly, the common method of casting piston rings, especially the smaller sizes, was from a long, cylindrical pattern This gives a casting, called a pot, from which a number of rings are cut in the machine shop. As may be seen this operation involves considerable expense, and in some shops it has been superseded by the method of casting each ring separately. The latter process involves a considerable increase in the expense of molding due to the proportionately large amount of sand and of gates and risers to the amount of metal in the casting. To lower the molding cost the Wasson company decided to cast the rings in gray iron molds, frequently known as permanent molds. By this method, metal in the smaller rings became chilled. Some of the larger rings were not chilled when cast in a permanent mold but enough of every lot was chilled, at least in spots, to make it essential that all rings be annealed before being machined. For this reason, it was decided to study the effect of annealing. Some of the rings which were white, having been chilled through, were annealed. Although malleable iron, which is also a white iron, requires a number of hours to be annealed, this metal with its higher silicon content was found to reprecipitate out a large portion of its carbon on being heated a few minutes and allowed to cool in the air. Not more than 10 minutes were required to cool the metal to a black heat when it could be quenched in water without deteriorating effects. While this treatment changed a large percentage of the carbon from the combined to the temper form and the metal became machinable, the annealed iron was not malleable and the hardness as determined by brinell test was 250 or a little less.

Noted Annealing Effects

The microstructure of the metal before and after annealing is shown in Figs. 2 and 3. In Fig. 2 the white areas are cementite and the small dark portions are pearlite. The dark spot which may be noticed in the upper left corner is free carbon, not in the flake form of graphite but rounded like temper carbon. Although the fracture of this iron shows white, there are a few of these spots of free carbon scattered through the metal. Analysis showed the following composition: Silicon, 2.40 per cent; sulphur, 0.104 per cent; phosphorus, 0.65 per cent; manganese, 0.35 per cent; total carbon, 2.91 per cent. Practically all of the carbon was in the combined state when the metal was cast. After annealing, the iron contains 2.86 per cent free carbon and 0.68 per cent combined carbon. The free carbon is in the form known as temper carbon, as may be seen from Fig. 3 which is an unetched micrograph. After annealing the sample has the appearance of malleable iron. The darker spots are the temper carbon. An etched sample shows that the background is mostly pearlite. Practically no ferrite is present and there is a far larger portion of pearlite than is found in malleable iron, owing to the higher percentage of combined carbon in the metal. This amounts to 0.70 per cent on the average Some rings of annealed iron were tried out in a gasoline engine but did not prove successful because they lost their tension rapidly and wore excessively. It was concluded that the heavy wear was due to the rounded particles of temper carbon which did

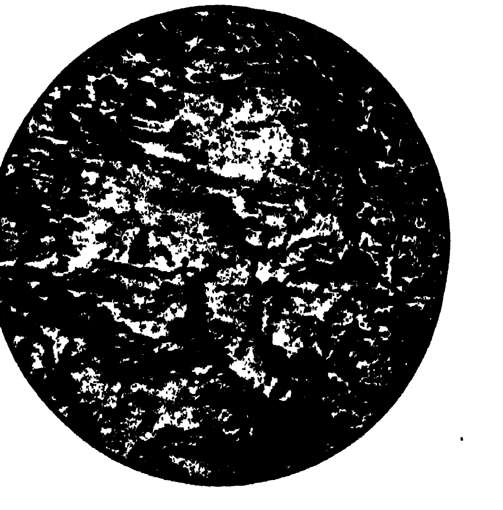
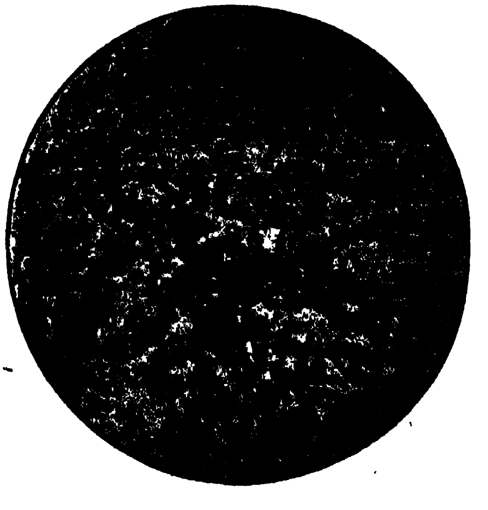


FIG. 4—AT THE LEFT—POT RINGS CAST IN THE SAND HAD THE USUAL APPEARANCE OF GRAY IRON WHEN MAGNIFIED 150 DIAMETERS—AS MAY BE NOTED, THE GRAPHITE IS SEGREGATED IN LONG NARROW FLAKES
FIG. 5—AT THE RIGHT—CENTRIFUGALLY-CAST METAL HAS A SOMEWHAT DIFFERENT APPEARANCE FROM THAT CAST IN THE REGULAR WAY—NOTE HOW MUCH MORE CONDENSED THE GRAPHITE FLAKES ARE THAN IN FIG. 4



not give as good lubrication as the graphite found in gray iron.

The results of the first annealing tests proved so interesting that further experiments were made to determine the effect of different annealing times and temperatures on the hardness of the metal. The results of these tests were as follows:

Time of annealing	Temperature Degrees	Brinell after annealing
1 min.	1850	250
1 min.	1850	250
3 min.	1950	241
5 min.	2000	238
45 sec.	1800	256
45 sec.	1800	250

The hardness of the different samples was so nearly equal after the foregoing anneals that it was decided to repeat the test, using greater variations in the time and temperature. This test gave the following results:

Time of annealing	Temperature Degrees	Brinell after annealing
30 sec.	1800	242
45 sec.	1850	250
1 min.	1900	242
1 min. 15 sec.	1950	235
1 min. 30 sec.	2000	235
2 min.	2100	242
3 min.	2200	260

Samples from each set of both lots were polished and examined under the microscope. All samples had approximately the same appearance as the micrograph, shown in Fig. 3, which has the carbon precipitated out in the rounded form instead of in the form of flakes.

Higher Carbon Effects

Tests then were made with iron higher in carbon and lower in silicon content. This iron was of the following composition:

Silicon	1.82
Sulphur	0.081
Phosphorus	0.68
Manganese	0.37
Total carbon	3.55

The following table giving the hardness numbers of samples of this iron annealed at different temperatures and for various durations of time shows that an increase of time or temperature or both does not decrease the hardness, but on the contrary the opposite seems to be true, as may be seen.

Time of annealing	Temperature Degrees	Brinell after annealing
5 min.	1900	273
4 min.	1850	273
3 min.	1850	273
2 min.	1800	256
1 min. 30 sec.	1700	259

These rings also were polished and etched and showed the same structure as the other annealed rings. The rounded form of the free carbon, having been shown by the practical tests in a gasoline motor to lack the lubricating qualities of the flaked graphite in the regular gray-iron castings, it was decided to endeavor to bring this temper carbon to the graphitic form. This was sought by redissolving it and again precipitating it out. As some of the rings already annealed had been heated to a mushy state it was determined that even a higher temperature would be necessary to redissolve the temper carbon. Pieces of rings were placed in a silica crucible and heated until the metal settled to the bottom of the crucible in the form of a button. The crucible then was taken from the furnace and allowed to cool in the air. A microscopic examination of the metal showed the carbon to be still in the rounded form of temper carbon. A second lot was melted and held in the melted state for 1½ minutes before being allowed to cool in the air. Upon examination, no graphitic carbon was found in this sample. A third sample was melted and kept in the furnace for three minutes. After being cooled in the air this sample contained a portion of its carbon in the graphitic form as was shown by the microscope.

Chill May be Eliminated

From the tests made by the Wasson company it developed that chilled iron which is hard and contains almost all of its carbon in the combined state can be made fit for machining by annealing. However, the carbon separates out as temper carbon and does not give the iron the lubrication which is obtained when the carbon is in the graphitic form. This makes such metal unfit for use in piston rings. The carbon change begins above the critical temperature, about 1300 degrees Fahr. and continues up to 2000 degrees when the maximum amount of carbon is precipitated. The maximum has been found to be about 80 per cent of the total amount of carbon in the metal. Thus an iron with 3 per cent carbon, which would be practically all combined carbon in the chilled state, will contain approximately 2.40 per cent temper carbon and 0.60 per cent combined carbon after being annealed a few minutes at 2000 degrees Fahr. It also was shown that this temper carbon which separates out between 1300 and 2000 degrees Fahr. cannot be turned to the graphitic state until the iron is actually melted for a space of time. These experiments convinced the company of the impracticability of casting piston rings in permanent molds.

FIG. 6—THE METAL IS MELTED IN A TILTING CRUCIBLE FURNACE AFTER HAVING BEEN BROKEN FINE—CHARCOAL IS ADDED TO THE LADLE TO PREVENT LOSS OF CARBON IN THE METAL BY OXIDATION

One other method of casting piston rings seemed to offer encouragement. This was some form of centrifugal process. A small section of the shop was equipped to conduct experiments with this method. The results obtained were so satisfactory that the company decided to extend its operations along this line.

The experimental department uses two crucible melting furnaces of the tilting type, furnished by the Monarch Engineering Co., Baltimore. These furnaces are heated by oil. The one is fitted with a crucible which will contain 180 pounds of metal in a heat, while the other is somewhat larger, accommo-

dating a crucible which will hold 450 pounds of iron. Experience has shown that crucibles will last slightly more than 10 heats, on an average. Scrap piston rings and gates and risers are the only stock used. This insures uniform metal from one day to the other and is highly important because the peening machines which hammer the piston ring and cause it to take its shape are set for a certain kind of metal. If the metal should vary from day to day the machines would form rings which would not be truly round and it would be necessary to readjust them frequently.

All of the scrap is broken into fine pieces before being charged. In this condition it will melt quicker and more can be placed in the crucible in the primary charge. Some of the broken scrap may be seen in the foreground to the left in Fig. 6, which shows one of the furnaces and two of the crucibles which are used in it. The cover of the furnace which has a circular hole fits down around the upper edge of the crucible which is closed with a loose-fitting cap. This arrangement prevents the flame from striking the metal in the crucible. The crucible is filled as full as possible with metal at the start and some charcoal is added. After the metal settles in the crucible on melting, more metal and, if necessary, more charcoal is added. At the end of the heat charcoal is floating on top of the melted metal. In this way the iron is kept thoroughly deoxidized and saturated with carbon. This practice brings the total carbon in the metal to about 3.50 per cent. The other metalloids in the iron are: Silicon, 1.90-2 per cent; sulphur, 0.1 per cent; phosphorus, 0.8 per cent; and manganese, 0.5 per cent. The carbon is divided into approximately 0.75

FIG 7—FOUR RINGS ARE CAST IN THE SAME MOLD—NOTE THE VERTICAL RUNNERS WHICH ACT AS FEEDERS

per cent combined carbon and 2.75 per cent graphitic carbon, but varies slightly according to the section of the ring into which it is cast. One of the important points in the process has been found to be the temperature of the metal when poured. It was learned from experience that metal poured below 2600 degrees Fahr. will form an imperfect ring. To test the temperature of the iron a No. 15 seger cone which melts at 2606 degrees Fahr. is placed on the bath and the metal is not poured until the cone is melted. Daily experience has taught the melter to gage this temperature accurately and the cone now is used in the ladle only once a week.

Piston rings from 8 to 29 inches in diameter have been made on the centrifugal machines. Two of these are installed. Rings up to 17 inches in diameter are cast in the smaller machine and the larger rings are cast in the other machine. The smaller machine with a mold ready to cast, is shown in Fig. 1. Molds are carried to the centrifugal machine by a chain hoist operating on an I-beam as shown to the right. For different sized rings different speeds of revolution are required as it is endeavored to revolve the flask at a speed which will produce a centrifugal pressure equal to 100 pounds per square inch. This requires on an average a speed of 300 revolutions per minute.

To obtain the different variations from this speed a friction cone drive shown in the upper portion of Fig. 1 is employed. The variation of speed is secured by moving a leather belt along the cone. This belt extends around the rear, or driving cone. As this belt is moved toward the small end of the driving cone this cone must make more revolutions to turn the driven cone one revolution and thus the speed may be varied. The cones are moved together to start the machine and the belt around the driving cone is thus pressed against the loose cone which it drives by friction. Five sizes of cast iron flasks are employed. In the smallest one, rings are made from 8 to 12 inches in diameter; the second size is used for rings from 12 to 15 inches in diameter; the third for rings

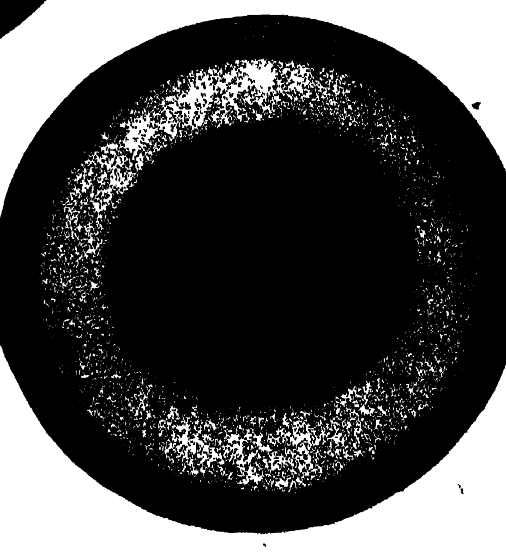
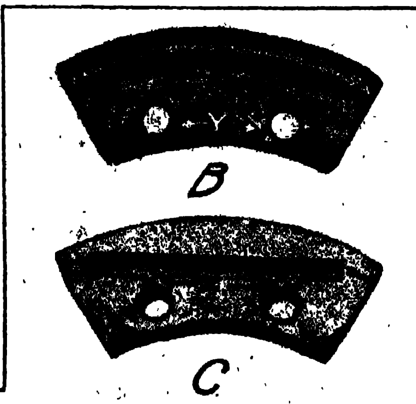


FIG. 8—ABOVE—A LAYER OF FLAT CIRCULAR CORES IS LAID AROUND THE BOTTOM EDGE OF THE FLASK AND THE CENTER COVERED WITH LOAM
FIG. 9—AT THE LEFT—CORES ARE LAID UP IN TIERS—TWO HOLES FOR THE RUNNERS ARE PROVIDED IN EACH SECTION OF CORE
FIG. 10—AT THE RIGHT—THE CORES ARE NOT PASTED BUT AFTER THEY ALL ARE ASSEMBLED A CAST-IRON RING IS BOLTED TO THE FLASK TO HOLD THEM IN PLACE

from 15½ to 17½ inches in diameter; the fourth for rings from 18 to 22 inches in diameter, and rings from the largest size flask range from 22 to 29 inches in diameter. An empty flask is shown in Fig. 12. To make the mold the inside of the flask is lined with cores which are held down by a circular cast-iron ring as illustrated at *A* in Fig. 1. This ring is attached by bolts through the holes in the flanged rim, which may be seen in Fig. 8. The cores are made in sections, five or six sections of a core being required to make a complete circle, depending upon the size of the ring to be cast. Six circular layers of cores form a complete mold for four rings. The cores are made of sharp sand with an oil binder. A rollover core machine built by Henry E. Pridmore, Chicago, is used. At present three cores are made at once in a wooden corebox but later metal boxes will be provided and five cores will be turned out at a time.

In building up the mold a circle is first made with cores like the one shown at A, Fig. 11. This core is ½-inch thick and from 3 to 3½ inches wide, according to the size of the ring to be made. The length is such that five or six cores will complete the circle, as has already been mentioned. This circle of cores serves as a guide for putting in the sand bottom. The bottom is made after the flask has been rubbed with core oil. The sand used is a mixture of sharp sand with fireclay, dampened to make it cohesive but not sticky. It is tucked in by hand and scraped flat, level with the core, after which it is slicked with a trowel and the excess is thrown out. A mold at this stage is shown in Fig. 8. The cores around the edge at the bottom of the flask are slightly darker than the loam towards the center. The pin indicated by the light circular area in the center is a part of the flask. It covers the hole in the bottom which is provided for screwing the flask to a center pin in the base plate of the centrifugal machine.

After the loam has been molded in the flask, the bottom is washed with graphite, and then skin dried with a gas flame. Later the flask is set on bricks and a gas flame is placed underneath it until the entire mold becomes thoroughly dried. This is only a temporary arrangement, which will be displaced later by oven drying. A continuous oven will be built through which the molds will be carried on an endless chain.



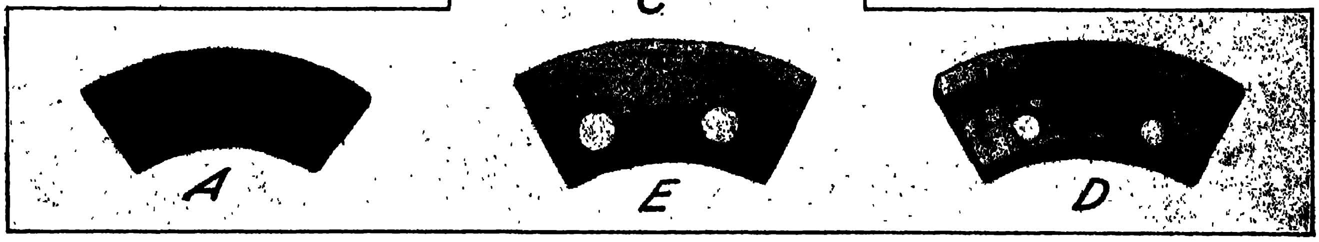


FIG. 11 RINGS OF CORES ARE SET IN LAYERS TO FORM THE CASTINGS—THE METAL GOES THROUGH THE GATES AT *Y* INTO THE RUNNERS FORMED BY THE HOLES IN THE CORES—FROM THE RUNNERS THE METAL GOES TO THE CASTINGS THROUGH THE GATES, *Z*, WHICH ARE IN EVERY CORE EXCEPT *A*

When the mold is dried a row of cores similar to the one shown at *B*, in Fig. 11, is laid around the edge of the flask with the face which is shown in the illustration turned down. The groove in this core layer forms a piston ring. Above this three more successive layers are laid using cores similar to the one shown at *D*, Fig. 11. Like the first layer these three layers are placed with the groove down. Once a week a layer of cores like the one shown at *C* is substituted for one of the layers of cores, *D*. As may be seen from the illustration the core, *C*, forms a long rectangular piece. As there are six of these cores in a circle, six of the rectangular pieces will be cast. These are used as test bars.

A core as illustrated at *E*, Fig. 11, is laid on to of the four layers of cores which form four piston rings, or three rings and six test bars if the test-bar cores have been used. On top of the core *E*, a layer of cores, *A*, is laid to act as the cover core. No paste is employed but the cores are held down by a cast-iron ring bolted to the top of the flask. A mold partly made is illustrated in Fig. 9, while one ready for the cast-iron cover ring is shown in Fig. 10.

The flask is screwed to the center pin of the centrifugal machine for casting. Metal is poured into the center of the flask after which the machine is started and the mold is revolved. The amount of iron to be placed in each mold is gaged close enough for practical operation by the quantity in a hand ladle used for pouring. Should the iron poured into the flask fail to fill the mold, the risers are not rounded out, as may be seen at *A*, Fig. 11. However, this does not affect the casting unless the amount of metal is so scant in the runners that it does not feed the castings properly. On the other hand, should too much be added to the flask, the metal does not all enter the mold but the excess stays around the inner edge of the mold and easily can be broken off when the mold is dumped and the castings cooled. The excess metal is prevented from flowing over the top of the mold by the cover core. This core, as may be seen at *E*, Fig. 11, is wider than the other cores and so extends further into the center of the flask and forms a wall or rim which prevents spilling over the edge of the flask.

When the mold starts to revolve the molten iron is in the center, as has already been stated. The machine is revolved at a speed to give a pressure equal to 100 pounds per square inch. The metal thus is forced into the mold through the only gates provided, which are in the lower tier of cores. These gates may be seen at *Y*, Fig. 11. It may also be noted that similar gates are not provided in the other cores as indicated in *D*, Fig. 11. Flowing through these gates the metal rises in the runners formed by the holes in the cores and through the gates *U*, in cores *B*, *C* and *D*, Fig. 11, to form the castings.

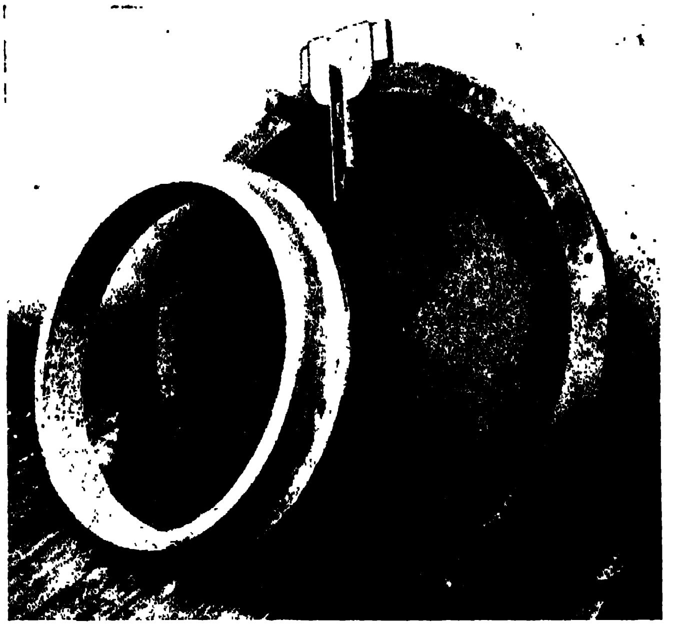
The mold is spun for about 1½ minutes by which time the metal has set. The flask is then removed from the machine and another put on. The mold usually is dumped at once and the flask returned to the molding floor, after first having been cooled with water. In this way only enough flasks are needed to take care of one charge of iron in each of the two furnaces. New molds are made each time while metal is melt-

ing in the furnace. Before the mold is dumped the circular cast-iron cover is unbolted and removed and a large proportion of the cores which have not been broken are recovered for use a second time.

A simple way of making a mold when it is inexpedient to make a core box is illustrated in Fig. 12. In this case only a few rings of a special size were desired. Instead of making a core box to produce cores for casting the rings separately, a lining of sand with a groove in it was swept with the crudely made sweep shown in the illustration. Although this sweep is constructed in the most simple manner, it performs its function credibly. When the mold was made a top core was placed and a cast-iron plate was bolted to the top of the difficulty was encountered due to shrinkage near the gates. This was overcome by increasing the size of the runners which now act as feed heads.

Briefly, the Wasson company finds in this process that the molds made in dry sand produce better rings, with all the benefits of dry-sand casting. The metal is cast under pressure and has a closer grain with greater strength. The loss due to dirty metal or other causes is small, as is also the percentage of metal in gates and riser. Much less sand is handled in making the mold.

The metal when cast in regular sand molds has a tensile strength from 20,000 to 25,000 pounds per square inch, while metal cast in the centrifugal machine will stand a pull of from 30,000 to 34,000 pounds per square inch. Tests are other dirt which may be present is held back in the risers. The success of the centrifugal method of casting piston rings has led the Wasson company to contemplate the installation of an electric furnace for melting the metal, to provide greater melting capacity.



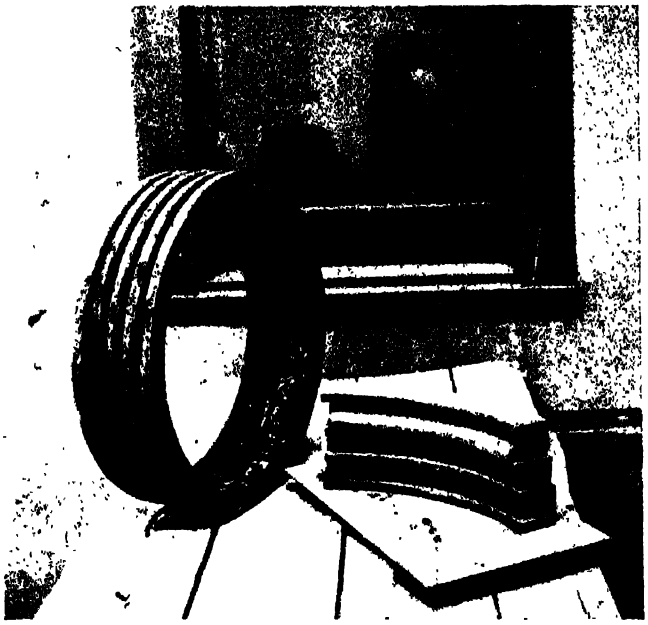


FIG. 12—A POT-RING CASTING WAS MADE BY SWEEPING UP A FORM IN A FLASK TO SAVE THE EXPENSE OF MAKING PATTERNS FIG. 13—ONE OF THE ORIGINAL WAYS OF CASTING RINGS WHICH DID NOT PROVE ADVANTAGEOUS

flask. The mold then was ready for casting. Extra machine work was required to cut the rings from this pot casting, and to turn off the extra metal which it was necessary to cast in the inside of the ring, in order to compensate for any variation in the amount of metal poured into the flask.

By the centrifugal method of molding as now practiced the casting is entirely surrounded by sand which prevents irregular cooling and chilling. A mold made of cores which did not entirely surround the castings was tried in the earlier experiments. It was made as illustrated by the section of cores shown in Fig. 13. This also shows the appearance of the finished castings, bound together by the cylinder formed by the surplus metal necessary to insure a sound casting. When molds first were made with the cores entirely surrounding the metal in the castings, made on test bars cast as already described. These bars are 9 x 3/4 x 1 1/8 inches and are machined for testing to a section 1/2 x 3/4-inch for a 2-inch length. The dense structure given to the metal by the pressure from the centrifugal force is illustrated by the micrograph, Fig. 5, which may be contrasted with Fig. 4. The latter is a micrograph from a ring cast in a sand mold. The graphite in the centrifugal-cast metal is shown to be in smaller particles and more evenly distributed than in the sand-cast metal.

The loss from defective castings in the centrifugal casting method will average 2 per cent which is much below the average loss obtained under the common method of casting piston rings. This loss may be accounted for partly by the fact that the heavier metal is thrown forcibly to the outside by the centrifugal pressure and any slag or

Handling Manufacturers to Hold Meeting

The Material Handling Manufacturers' association will hold an open convention at the Waldorf-Astoria hotel, New York, on Feb. 26-27. Manufacturers from any part of the United States will be welcome, especially companies manufacturing overhead, locomotive, gantry cranes, hoists, winches, portable, gravity and power conveyors, industrial trucks, tractors and trailers, bulk handling machinery, elevators and all forms of equipment and supplies used in the construction and operation of mechanical handling machinery.

Arrangements have been made to hold a morning business session on Friday, Feb. 26, which will be followed by a formal luncheon at the Waldorf-Astoria. The afternoon session will be devoted to papers and discussions on mechanical handling problems. A number of papers will be illustrated by moving pictures, showing views of some of the latest and largest installations.

Reservations for the luncheon may be procured from W. J. L. Banham, Otis Elevator Co., New York City; Chas. A. Rohr, General Electric Co., New York City; Richard Devens, Brown Hoisting Machinery Co., New York; or from the secretary and manager, Zenas W. Carter, 35 West Thirty-ninth street, New York.

Advantages of Uniformity in Costs

An Accurate Cost System Based on a Uniform Plan is Only Successful When it Serves With Equal Fidelity the Sales, Production and Financial Departments

BY C. E. KNOEPPEL

PERHAPS the greatest problem before American industry today is that of determining accurate cost of production. Industry is becoming so complex, tax laws are so intricate and the matter of accurate returns are so important that the concern operating without knowledge of costs, is in the worst possible position to conduct its business to the best advantage. Another and perhaps the most important reason why costs must be accurately ascertained, is to enable the manufacturer to determine just what he can do in the way of increasing wages and arranging for profit-sharing plans. He must know where he stands with reference to his production costs

There are three factors which whether considered separately or in combination, can cause distress to an industrial concern. These are: Lack of systematic production methods, failure to ascertain accurate costs, and lack of uniformity in costing or in bidding on work.

Comparison Not a Solution

It is difficult to bring about agreements as to prices but a careful study of the situation leads to the conclusion that agreement as to price is not necessary. The comparing of bids is not altogether an essential. Combination to control a local situation is not the solution. There should be such uniformity in ascertaining and compiling costs and making estimates as to insure against wide differences in prices. Every manufacturer who furnishes a product of good quality and who can make reasonable deliveries is entitled to his share of the available business at a fair and reasonable margin of profit. Any concern which purchases a product below the cost of production is enjoying something to which it is not entitled and which really belongs to the manufacturers of the particular product.

If, after providing uniformity and accuracy in cost keeping, a concern finds that it is consistently higher in its bidding than others, it can only mean that it is not operating efficiently, or that it is adding too much profit to its costs. Knowing these things, the company is in a position to check up its weak spots and determine where the faults are and then correct them. Uniformity in costs means intelligent competition as well as furnishing a means for increasing operating results. Many manufacturers admit that they have no objection to the hardest kind of competition when they know that their competitors are operating intelligently along uniform lines and with full knowledge of the true conditions.

Recently a concern contracted to furnish castings at $2.85 per 100 pounds. When it became apparent that money was being lost somewhere, an investigation was made with the result that the actual cost of this particular work was found to be between $4 and $5 per 100 pounds. This naturally brings up another point. Not only does the buyer profit to the extent of the difference between the cost to the foundrymen and the price the buyer pays but he will expect some of the other foundrymen when the present contract expires, to furnish him castings for a price not much in excess of $3 per 100 pounds. If he cannot get a quotation near this figure he will advertise his requirements until some foundryman who must have the work at any figure, or who does not know his exact costs, will give him a bid that is satisfactory, and as a result the honest, intelligent foundryman is placed at a decided disadvantage. But was not some foundryman to blame in the first place?

Crowding Bidders

A manufacturer wires that he is in the market for castings, offers prints and specifications and the foundryman makes him a bid on the work. Later the manufacturer tells the foundryman that his price is too high and that as long as he cannot give a better price the manufacturer will be forced to place his contract elsewhere. The manufacturer no doubt advanced the same argument to all who bid on the work. It is often done. He is secure in his belief ,that each one is in ignorance of the prices quoted by the others and as a general rule he is in a position to say that he has an even better price than the lowest quoted. The result is that the contractor not only bids against the others but worst of all he bids against himself.

Men go into business to make money and to do this there must be profits. There can be no profits unless costs are less than prices. Therefore costs should be known. The accounts should show what it costs to run a buiness. If costs are high the system should show where they are high and why they are high. An average cost means nothing at all except that some castings cost less and some cost more. A true cost system should show how much more and how much less.

Uniformity Essential

All agree to some extent that cost accounting is necessary, but there is something more important, however, than for each to have a good cost system. The basis for costs should be uniform so that all will figure along the same general lines Even if 10 factories should put in cost systems, as complete as 10 different experts could make them, assuming that each one was different from the others, the net result to the individuals and to the industry would be worthless and time and money would be wasted.

It has been found by experience that unless four principles are incorporated in cost systems, they fall far short of performing their real functions. These principles are:

A cost system to be of the greatest possible value to a business must serve the three principal divisions of the business, namely sales, production and financing.

It is necessary to predetermine the time and cost of every job and to control production so as to watch fluctuations and exceptions with a view to reducing costs, while the work is being done.

From the standpoint of estimating and business getting, costs can only be used to advantage as a rule when the plant is operating at or about normal capacity. By normal is meant

Abstract of paper presented at the annual meeting of the American Foundrymen's association, Philadelphia. The author, C. E. Knoeppel is connected with C. E. Knoeppel & Co., New York.

from 80 to 90 per cent of the possible capacity of the plant. For this reason while providing for actual costs, standardization of cost rates, especially overhead rates, should be arranged for in order that estimates may be more uniform and the costs made of real value to the sales and production departments.

Cost finding should be arranged so as to make the most complicated work net the greatest returns in profit. As the time of workmen and equipment are the productive investment in a business, it stands to reason that a man should get more for a job taking $300 in labor than one costing $150 for labor, and the cost keeping and price making should reflect and reconcile these differences.

It is not sufficient to have a system which may be perfect from the financial standpoint, but which gives the production division of the business so little in the way of available cost data as to make it impossible for it to assist in reducing costs, nor is the cost data of assistance to the production division if the cost information is presented so long after the operation which the figures represent as to make it next to impossible for a man to remember what caused the fluctuations. Certainly there is no advantage to the sales manager if he can only rely on the cost figures when the plant is operating at normal capacity.

Financial or Engineering Costs

In a certain plant both the treasurer and the production manager wanted a cost system, but each one wanted a different kind of a system. The treasurer wanted a financial accounting system to show his directors where the money was spent, and why, making the shops fit with his plans instead of basing his work on manufacturing conditions. The production manager on the other hand, advanced the argument that he was employed, first, to get out production as rapidly as possible, next to keep the expense down to a minimum and finally to render a proper accounting for the time and cost put in on work. In other words, the one wanted financial costs, and the other engineering costs. The one wanted to be a historian delving into the past, while the other preferred to be a prophet looking into the future. One would make cost a prime consideration of the business and the other would make it a part of manufacturing. The production manager was right.

If a careful estimate is made prior to starting the work, it offers something to aim at and enables a constant check on results during the time work is being made. Knowledge of actual costs may serve to enable a man to do better next time, but predetermination will assist materially in keeping costs within certain limits. During the early part of 1908 the writer took charge of a large plant in Pennsylvania, comprising a structural shop, machine shop and foundry. The burden accounting employed at the time gave the machine shop more profits than it was entitled to, while the structural shop was showing profits less than those actually made. The foundry was selling castings to the machine and structural shops at actual cost, which did not include any proportion of the overhead expense of the company. In the changes that followed, each department was put on its own feet through the books of the company, with provision for monthly profit and loss statements. At the time the methods were introduced in the concern in question, the business was making very little money. Its sales were not large and it was a heavy borrower, with a pattern account far in excess of real value. It had a bond issue hanging over its head. Today this plant with two additions, is doing a capacity business, making excellent profits and declaring dividends. It is discounting its paper and has retired its bonds, while the pattern account is where it belongs.

The theory which the author had in mind was that the greatest volume of business could be secured only when the plant was operating at about normal. With high production meaning low cost, and low production high cost, under the usual method of accounting it meant that the sales and cost divisions came into conflict both when costs were high, which operated against obtaining business, and when costs were extremely low due to abnormal business, which resulted in quoting prices lower than would be necessary to secure the business.

Must Meet the Test

A concern is in business to sell. It may make what it can sell, or sell what it makes, but selling is the fundamental basis of any business, a point which many accountants and industrial engineers seem to forget. If, as a sales manager, I cannot sell goods because due to conditions being below normal my prices are too high, or because of an abnormally high production my prices are lower than I know I can get for my goods, I don't need to be an industrial engineer nor an accountant to know that something is radically wrong with the whole thing, both in theory and in practice.

With standard rates, however, reflecting normal conditions, I am assured against loss of business on the one hand and loss in prices on the other. I know also that on this basis the line which is profitable in the shop will show profits, whereas through operating on a low production basis the increased overhead will not only wipe out the profits, but make the line show a loss.

The most advanced doctrine of management is that the unit sold is really the time of equipment, the time of the workmen, the time money is tied up in materials, the time of clerical help, the time of storing materials in a given place, the time of making rigging, the time of transferring materials from one place to another, and the time of inspection. If there are delays or enforced idleness at any of these points the result will be high costs, which make for high prices.

Eight Points Urged

The eight requirements for foundry cost system are:

Cost of labor and material should be accurately determined and properly classified.

The expenses of a business or overhead or burden as it is called, should be carefully compiled and classified.

The apportionment of overhead to production must be arranged on some basis as will not make the cost of heavy work too high nor the cost of the light work too low, otherwise the result will be loss of sales on heavy work and plenty of light work at low prices.

Those who purchase castings should pay most for those which cost the most to produce, as reflected by the time taken to produce them.

Costs vary with productivity by which is meant the relative amount produced per man per day. The work of a man producing a ton per day costs less per 100 pounds than that of a man who produces only 500 pounds per day and the cost should reconcile this difference. In other words, consideration should be given to the fast and slow moving jobs.

Costs should be classified according to whatever plan will best meet the particular conditions. This can be done according to classes of work, kind of molding, separate patterns and classes of patterns, kind of cores, character of cleaning, according to departments, and by classified weights. Provision in all cases should be made for determining the cost of individual patterns.

Costs should be placed on a 30-day basis offering 12 opportunities per year for locating and correcting faulty conditions.

Costs should be based on standard rates for the various items in order

DATA ON CHIMNEY DESIGN

By J. G. Mingle

Capacity of Chimneys

By the capacity of a chimney is meant the theoretical amount of fuel it will burn during a stated interval and consequently the theoretical amount of gases it will pass in the same time. The theoretical amount of fuel a chimney will burn is determined by the formula

$$W = W_o \sqrt{2\,gH\left(\frac{T_o}{T_c} - \left\{\frac{T_o}{T_c}\right\}^2\right)}$$

when W = weight in pounds of the gases passing any point in the chimney per second,
W_o = weight in pounds of a cubic foot of air at T_o,
g = acceleration due to gravity feet per second per second,
H = height of chimney in feet,
T_o = absolute temperature of outside air in degrees Fahr.,
T_o = absolute temperature of chimney gases in degrees Fahr.

With an outside air temperature of 60 degrees and an average chimney gas temperature of 600 degrees the above formula reduces to

$$W_h = 302\,D^2\sqrt{H}$$

whence $D = \sqrt{\frac{W_h}{302\sqrt{H}}}$

where D = diameter of chimney in feet,
W_h = weight of gases passing any point in the chimney per hour.

It is more convenient, however, to express the capacity of a chimney in terms of horsepower equivalent. Assuming that each pound of coal requires 24 pounds of air to burn it and that each boiler horsepower requires 5 pounds of coal per hour, the horsepower of a chimney equals

$$HP = \frac{385}{24 \times 5} A\sqrt{H}$$

whence $D = \sqrt{\frac{HP}{2.52\sqrt{H}}}$

where HP = rated horsepower of chimney.

Fig. 1 shows the diameter of a chimney required for the different horsepower with the heights as indicated.

The formulas and the accompanying curve hold approximately true for oil, coke and gas burning equipment.

Example: Find the diameter of a chimney 150 feet high with a horsepower equivalent of 1500.

Reading directly from the curve the diameter is given as 7 feet.

(Concluded on Data Sheet No. 322)

DATA ON CHIMNEY DESIGN

By J. G. Mingle

(Concluded from Data Sheet No. 321)

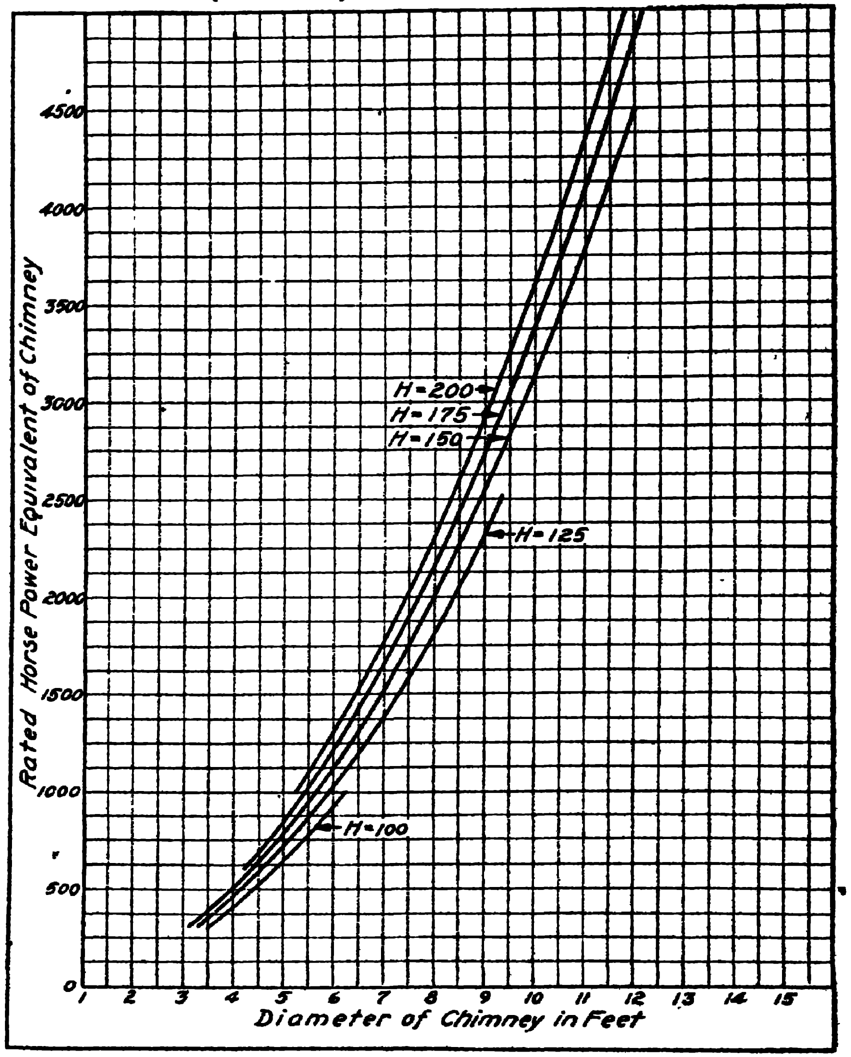


FIG. 4—CURVES GIVING DIAMETERS OF CHIMNEYS

to enable a foundry to operate and make prices based on normal conditions.

With the four principles incorporated in the cost system, and the eight requirements met, the following may be expected as results:

Elimination of guess work in price making.

Knowledge that all items are included.

The right kind of a basis for predetermining production rates and costs.

Intelligent apportionment of overhead.

Comparison of work between different plants.

Close watch on work running over estimates

Discouragement of price cutting.

Better prices.

Stronger institutions financially.

Valuable data.

Betterment to the entire industry.

In presenting this argument more attention has been paid to principles, laws and economic considerations than to the methods and forms, which after all are only incidental considerations.

If the basis of investigation is right, the factors have to do with gathering and compiling cost data are easily within the control of any competent cost accountant or organization specializing in cost accounting

Composition Alters Properties of Copper

INFLUENCES governing the physical condition of copper are outlined in a paper prepared for the February meeting of the American Institute of Mining and Metallurgical Engineers, by Frank L. Antisell, superintendent of the Raritan Copper Works, Perth Amboy, N. J. In discussing the pitch and set the author says that the appearance of the surface of the copper when cooled is considered as to its *pitch*, or the general contour of the surface and the shape, which may vary from a concave to a convex. The *set*, is the detail appearance of the shape, the wave-like structure. When the shape presents a concave surface, it is known as *low pitch;* a convex surface is known as *high pitch* or *tough pitch*, and a level surface is called *flat pitch*. The set of the copper is, in a very large measure, directly related to the pitch; and so intimately are these characteristics connected that they are often used as synonymous terms by the refiner when he is speaking of well-refined copper. If, however, he is speaking of unhealthy or improperly refined copper, he will define both the pitch and the set. The character of the set will show whether the copper is low pitch but healthy, or low pitch but unhealthy and must be refined again. High-pitch copper is usually described in terms of the set. If the set is very close and even, the copper contents are about 99.95 per cent. This close set cannot be produced on a shape with a low pitch.

The influence of oxygen is discussed by the writer who calls attention to the fact that metallurgically, the copper presents the best general characteristics when shapes of a certain size present a slightly convex contour, high pitch, with a good set and close grain. While a shape of a certain weight presents a satisfactory appearance, it does not follow that larger or smaller shapes will be the same. As a general rule, the thicker the shape, the less oxygen is permissible in it; the thinner the shape the more oxygen may be present. Oxygen is, therefore, often spoken of as a medicine for copper, it being used to regulate the pitch. While the pitch may be flat or slightly convex, it may be decidedly inferior if it presents a coarse grain.

Copper containing an excessive amount of oxygen that is introduced during the refining period is known as *set* or *dry copper*. As the amount of oxygen decreases and approaches the percentage found in satisfactory metal, the copper is said to be underpoled. When the metal is thoroughly refined, it is known as tough pitch. The fracture of tough copper must exhibit a decided metallic luster; a brick-red shade is indicative of undesirable oxygen contents. With low oxygen contents, copper may be heated over a long period with the formation of a very slight coating of oxide, while with higher oxygen contents, the copper oxidizes quickly.

The general physical properties of copper change in a marked manner with the increase of sulphur it is said. An increase in the sulphur contents affects the number of bends in a very much greater ratio than does oxygen. Unhealthy copper contains slight quantities of gases, such as hydrogen, carbon monoxide, sulphur dioxide, and carbon dioxide. If an attempt is made to remove the excessive oxygen, the copper will spew; that is, a miniature volcanic action will occur in the shape and the copper will be known as overpoled. Copper in this state will be low in electrical conductivity and have a small reduction in area, due to several reasons, particularly the excess of oxygen. These properties can be improved only by subjecting the entire charge to a refining process, which consists of oxidizing the copper, thus removing the reducing gases, and then poling the copper up to a tough pitch. Unhealthy copper may present either a high or a low pitch, but if an attempt is made to raise the low pitch, the copper will spew.

Proper care in the annealing of copper is often neglected, it is pointed out. On this account the maximum elongation is seldom obtained, and this is necessary where the metal must stand a large amount of work in being fabricated. Extremely tough-pitch copper exhibits great ductility, and if it is given improper treatment in the mill it may tend to shred or tear the surface of the copper.

When such a piece of copper is pickled, the shreds, not being oxide, do not dissolve in the solution, thus resulting in an imperfect surface. If the copper is not so tough, these slivers may be entirely detached or will not be formed at all, due to the thick veneer of scale. While copper may occasionally be preferred with such properties, it is at the expense of the physical characteristics of copper.

Increases Blower Plant

The Ohio Body & Blower Co. is a natural outgrowth of the Ohio Blower Co., Cleveland, which started 18 years ago to manufacture a patented exhaust head and also to manufacture and install dust collecting systems. Other lines which include steam and oil separator steam traps, water level control valves, feed water heaters, ventilators, core ovens and core oven equipment were added from time to time. The company furnished the government a large quantity of standardized ship cowls complete with turning gear, during the war.

Immediately after the armistice was signed the company decided to enlarge the plant and enter extensively into the production of motor car bodies The new branch of the business has been working to capacity since its inception. The company now operates three plants and it is proposed to add another unit to the new plant in the spring. The change in the name of the company will not affect the personnel in any way.

Melting Iron With Powdered Coal

Small Air Furnace Melting Malleable Iron is Equipped With a System For Burning Powdered Fuel—Comparison With Handfiring Shows Economy of New Installation

POWDERED coal for some years has found favor among malleable iron foundries. Its main use has been confined to annealing furnaces until within the past year, when equipment has been installed which uses this fuel as a melting agent in air furnaces. At the plant of the National Malleable Castings Co., Chicago, is a particularly interesting powdered-coal burning system which has been under observation for the past six months. This installation was made by the Combustion Economy Corp., Chicago.

The complete equipment, which was manufactured under patents held by A. J. Grindle, president of the Combustion Economy Corp., includes a storage hopper, a system of screw feeds which deliver the coal into an air passage where by a series of mixing devices the air and fuel are blended thoroughly and delivered through a pipe into the main combustion chamber of the air furnace Five burners are provided, each being fed by a separate screw, but only three burners have been connected to the furnace These furnish ample heat, as the furnace has only 10 tons capacity and the normal melt is 9½ tons. The length between bridge walls is 15½ feet; the width at the tap holes is 5½ feet; the firebox is 40 x 59 inches; the diameter of the stack is 29 inches; the height of the wall at the tap holes is 31 inches, and the depth of the bath at the tap holes is 9 inches The only changes made to adapt this furnace to powdered coal melting consisted in raising the front of the firebox from 3 to 6 inches, filling in the ash pit, lowering the front bridge wall and removing the top blast. Hand fired coal was used previous to installing the powdered fuel burner.

The burning system has a number of features which are unique in powdered coal firing practice. A typical installation and one which resembles that at the Chicago plant of the National Malleable Castings Co. is shown in Fig. 2. The main point of difference between the latter and the type shown in Fig. 2 is the use of a separate motor to drive the coal feeding mechanism at the National foundry. This motor is connected through a special variable speed drive to the line shaft which operates the individual feeding screws through gears.

The tendency of powdered coal to pack at the point where it is delivered from the storage bin is obviated by a liberal opening in the bottom of the supply hopper, which feeds the three worm feed pipes. A specially designed four-flight screw in each of these delivers a continuous flow of coal at the outlet of the delivery chamber. Packing, which is a common source of trouble shown by an intermittent or pulsating flame, is entirely absent in this type worm-feed.

At the delivery end of each screw

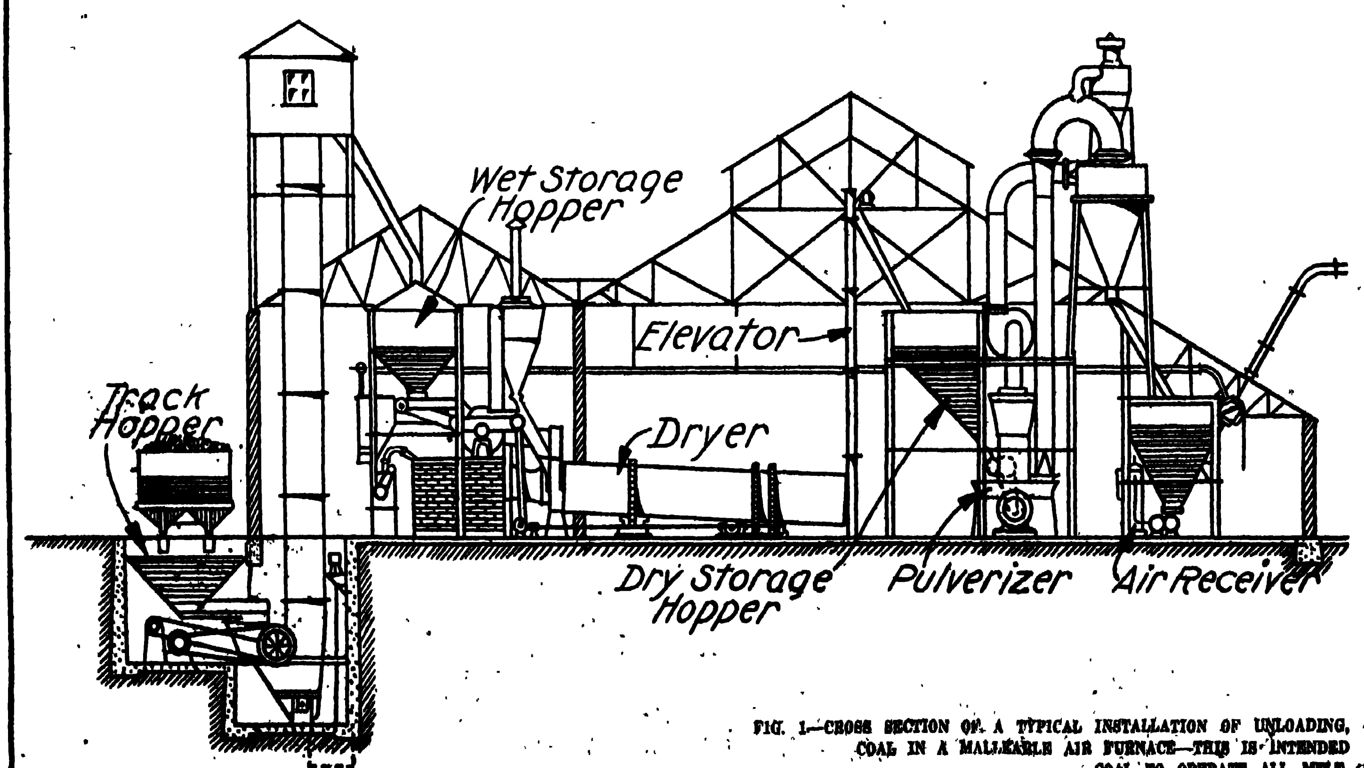


FIG. 1—CROSS SECTION OF A TYPICAL INSTALLATION OF UNLOADING, COAL IN A MALLEABLE AIR FURNACE—THIS IS INTENDED COAL TO OPERATE ALL MELT-

shaft is a disk, keyed to the shaft and provided with a series of spiral ridges on the surface which is at right angles to the entering stream of coal. This disk resembles the plate used in an old fashioned coffee mill or corn sheller. The ridges in the surface radiate from the center to the outer edge. When the stream of coal strikes this rotating disk, it is broken up and thrown outward by centrifugal force, aided by the ridges in the face. Here the entering blast of air strikes and mingles with the powdered coal, carrying it upward through the conveying line shown in Fig. 2. Just beyond the upward bend of the conveying line is a stationary mixer which fills the entire circumference of the conveyor. This is supplied with a number of vanes set at different angles, which act as baffles and impart a whirling motion to the entering column of air and powdered coal. This gives a more intimate mixture of the two elements before they reach the nozzle or point where combustion starts at the entrance to the furnace. The distance from the point where the screw delivers the coal into the air line, to the carburetor indicated in Fig. 2 may be from 3 to 100 feet.

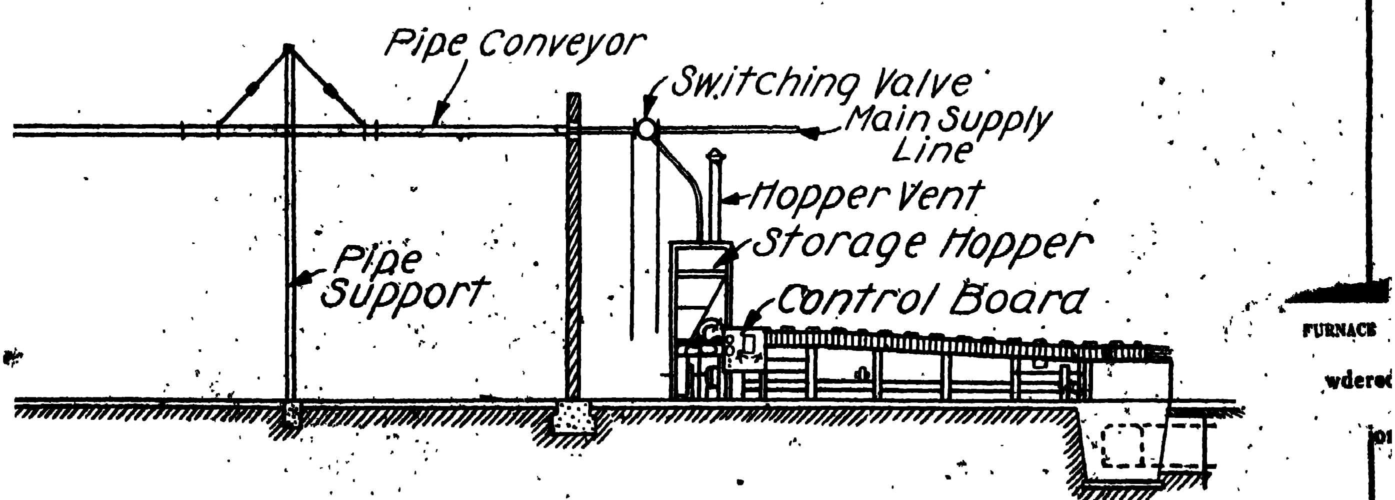
Air for the system is supplied by a low pressure blower direct connected to the driving motor. The air is controlled by a specially designed gate with an indicator showing the number of square inches of opening in the supply pipe. In addition, adjustable markers corresponding to determined coal screw speeds enable the operator to sycronize the coal and air supply by setting the indicator to a corresponding number. By this method, the markers may be set in accordance with the carbon dioxide analysis of the stack, and no variation is necessary unless the grade of coal used is changed. This relieves the melter of some responsibility, for when the proportion of air and coal is once determined, the sycronizing device assures the constant maintenance of the correct mixture for the best combustion. A speed change box connected to the coal screw shaft provides accurate control over the amount of coal which is fed into the air line. This speed changing device is marked to indicate the amount of fuel which is delivered at each point in the regulation.

The outer or delivery end of the carburetor is flattened into an oval

Table I

Record of Typical Day's Run with Powdered Coal

	1st Heat	2nd Heat	3rd Heat
Start	1 30 A. M	8 10 A. M	1·05 P. M.
Heat ready	4 hrs 30 min	3 hrs. 40 min.	3 hrs. 25 min.
Heat out	6 hrs 15 min	4 hrs 15 min	4 hrs. 5 min.
Tons melt	9 21 tons	9 21 tons	9.19 tons
Melt per hour total time	1.47 tons	2 17 tons	2.25 tons
Melt per hour until hot	2 46 tons	2 58 tons	2.68 tons
Pounds of coal used	7215 lbs.	4973 lbs	4775 lbs.
Coal per ton	783 lbs	538 lbs	508 lbs.
Per cent of coal to iron	39 6%	26.9%	25.4%
Per cent pig iron in charge	42 7%	40 8%	41 24%
Silicon in charge	.985%	.976%	.976%
Manganese in charge	.46%	.58%	.58%
Analysis of metal produced: Silicon	.82%	.83%	.85%
Analysis of metal produced: Sulphur	.07%	.068%	.076%
Analysis of metal produced: Manganese	.34%	.37%	.44%
Analysis of metal produced: Carbon	2 00%	2 58%	2.66%
Tensile strength	53,800	56,150	53,000
Elongation in 2 inches	13%	11%	12 5%



CRUSHING, DRYING, CONVEYING AND BURNING SYSTEM FOR USING POWDERED FOR USE IN A PLANT WHICH WILL PREPARE SUFFICIENT ING AND ANNEALING FURNACES

shape, with the long axis horizontal. This allows the flame to spread out across the furnace and ignite more readily. In operating at the Chicago malleable plant, the proportion of air and coal is so adjusted that a short direct flame melts the metal at the start of the heat. When the bath is thoroughly melted, the flame is lengthened and directed in such a manner that a current is set up over the surface of the molten metal. This pushes the slag toward the back

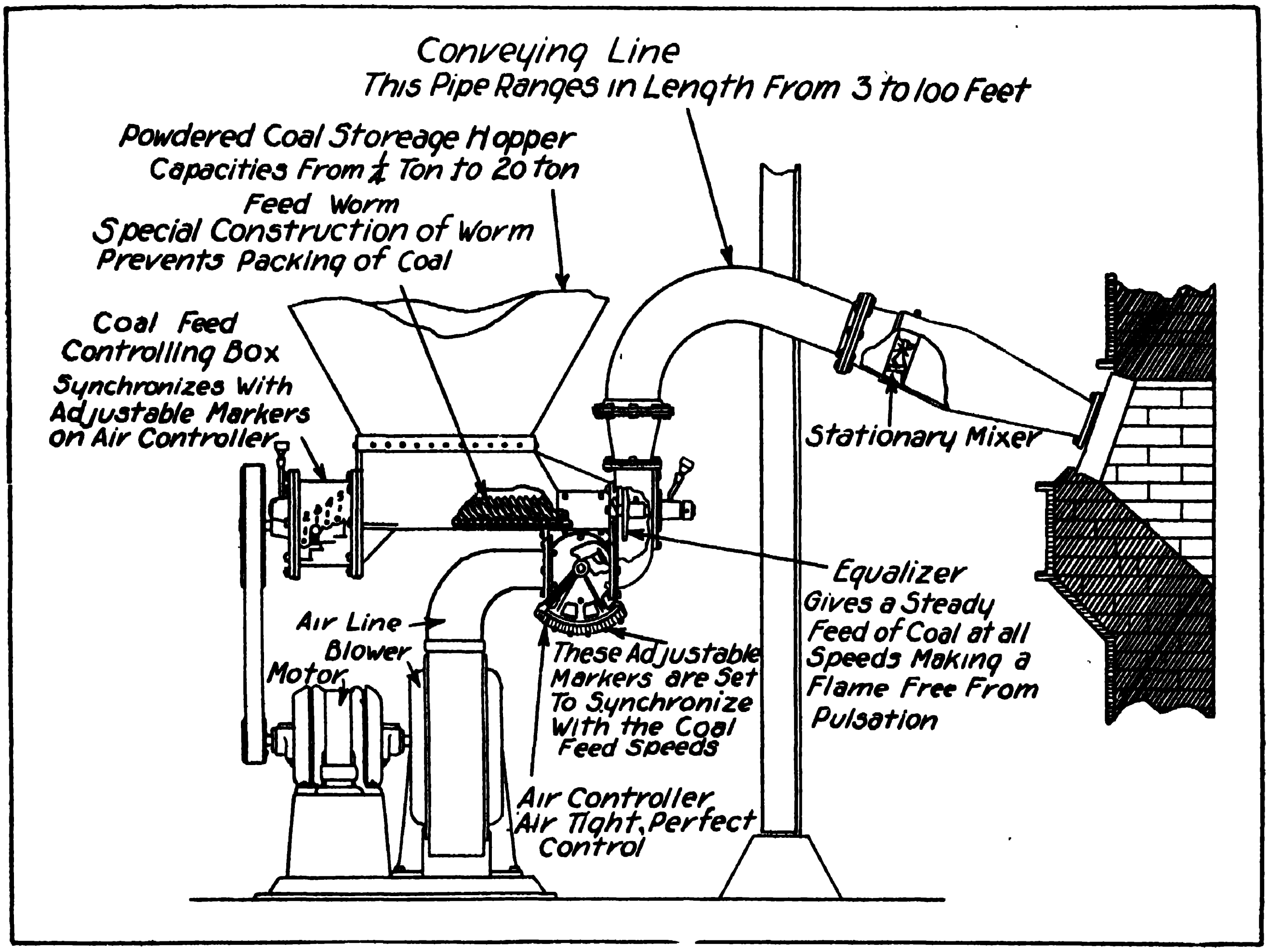


FIG. 2—DETAILS OF A POWDERED-COAL BURNING SYSTEM, SIMILAR TO THAT INSTALLED AT THE CHICAGO PLANT OF THE NATIONAL MALLEABLE CASTINGS CO.

of the furnace and assists in mixing the entire bath in a way which promotes [illegible]eity.

[illegible]rage practice with the system at [illegible] National Malleable plant requires [illegible]o or three melts a day, although at [illegible]mes only one melt is made. Between Sept. 9 and Dec. 3, 1919, 84 heats were melted in this furnace. Table 1 gives the record of an average day's run. In this case three heats were made. The first was melted within 4 hours and 30 minutes, the second in 3 hours, 40 minutes and the third in 3 hours and 25 minutes.

A control board has been devised, to furnish a guide for the melter operating the powdered coal equipment. Data secured from actual trials provide a guide for the proper control of apparatus on all other heats. Thus the proper air inlet, together with the best screw feed speeds at the start of the heat were determined. Then the time interval until the next change was necessary was noted. An adjustment in the relative quantity of air and the amount of coal fed was made when the slag was skimmed, when tests were made and when the heat finally was ready. These were noted with the corresponding time intervals. The control board carries these data, and shows the operation of burner system in a simple manner.

A continuous strip of paper, marked off into the hours of the day and 20-minute intervals is mounted on two rollers back of the cardboard face of the control board. The proper adjustments of air and coal feed at the various intervals are indicated in columns to the left. The quantity of air delivered is shown by numbers corresponding to the three air inlet openings, while the revolutions per minute of the three coal feed screws, which are operated through gears from a common drive shaft, are indicated in another column.

In using the control board, the slip containing the time intervals is rolled around until the hour of the day when the flame is lighted is shown opposite the start position on the control board. Then the necessary changes in air or coal feed are shown opposite the required time on the board. A typical instance showing the use of the device for an initial heat is shown in Fig. 3.

A close study has been made of the economy of powdered coal at the plant of the National Malleable Castings Co. The chief chemist, John Birdsong, together with A. J. Grindle, of the Combustion Economy Corp., has compiled comparative cost figures using as a basis data which were secured when the furnace was hand fired with coal and those which have been obtained with the powdered fuel.

Table 1 gives a record of an average days run, using powdered coal. In this case the first heat was held 55 minutes awaiting the arrival of molders to pour the metal. This

delay resulted in the consumption of 1072 additional pounds of coal. Pouring was started at 6:35 a. m., but sufficient labor was not at hand to pour continuously and leave the tap hole open, until 6:55 a. m. This increased the ratio of coal to iron from 33.3 per cent to 39.6 per cent. The slight loss of silicon shown is commented upon as a factor of economy. A larger proportion of scrap may be used in the charge, as it is not necessary to add pig iron to compensate for the loss in silicon. It is said that the loss in both silicon and carbon is less in powdered-coal burning furnaces. The average amount of pig iron used in the furnace when hand fired was 47 per cent. With powdered coal, this was reduced to 41 per cent.

The costs given in Table II are compared upon a common-basis of cost for labor and materials. The powdered coal costs were taken from a five day run during which 11 heats of 9½ tons were taken. The difference in iron cost is attributed to the saving due to the use of scrap. In this case the cost of pulverizing the coal was charged at $2.68 which is higher than the cost would be in a plant in which a large amount of coal is handled.

An analysis of the coal which was used in this test follows:

ANALYSIS OF COAL USED

Moisture	1.64
Fixed carbon	54.98
Sulphur	.768
Volatile matter	37.43
Ash	5.95
B.t.u.	13,606

SIEVE TEST

200 mesh	76%
240 mesh	72%
300 mesh	56%

As may be noted from Table II, a saving of $1.043 per ton is shown by using the powdered coal process on this furnace. The saving in a melt of 9½ tons therefore is $9.908 or $19.816 per day with two heats per day. If conditions required, three heats per day could be obtained without difficult, and better economy would be shown in the heats which are made after the furnace is hot.

A smaller amount of slag is formed in the furnace now than when hand firing was used. This is explained by the lower percentage of silicon, manganese and carbon which are oxidized from the metal. The ash from the powdered coal does not make up for this decrease in quantity of slag as is shown by the amount of material which is skimmed from each heat. The powdered coal equipment reduced the slag from seven or eight truck loads to three or four truck loads. The ash which is deposited in the bottom of the stack averages about three wheelbarrow loads a week at the present time.

It will be recognized that the furnace to which this equipment was applied is small. The makers state that greater savings can be shown with a larger furnace. Further economy in actual operation will be possible when conveying equipment which has been purchased is in use. The present crushing and drying plant will provide sufficient fuel for additional air furnaces, as well as annealing ovens which have used powdered coal for a number of years.

A typical powdered coal installation, including the crushing and conveying equipment, is shown in Fig. 1. At the left is the crushing, drying and transferring machinery. Coal is unloaded at the extreme left, passing down into a hopper and thence by an elevator to a hopper which feeds into the wet storage hopper. The coal next is passed over a magnetic

(Concluded on page 150)

Table II

Comparison of Costs Between Hand-Fired and Powdered Coal Burning Methods

	Cost of average hand firing	Cost of powdered coal firing	Savings of powdered coal per ton	Savings of hand fired per ton
Labor	$ 1.090	$ .743	$ .347	....
Iron	22.040	21.517	.523	....
Coal	2.565	2.630	.000	.065
Skimmers	.184	.145	.039	....
Brick	.795	.561	.234	....
Extra electric power	.000	.035	.000	.035
Total	$26 674	$25.631	$1.143	$0.10
Net savings of powdered coal per ton melt	.....	.....	....	$1.043

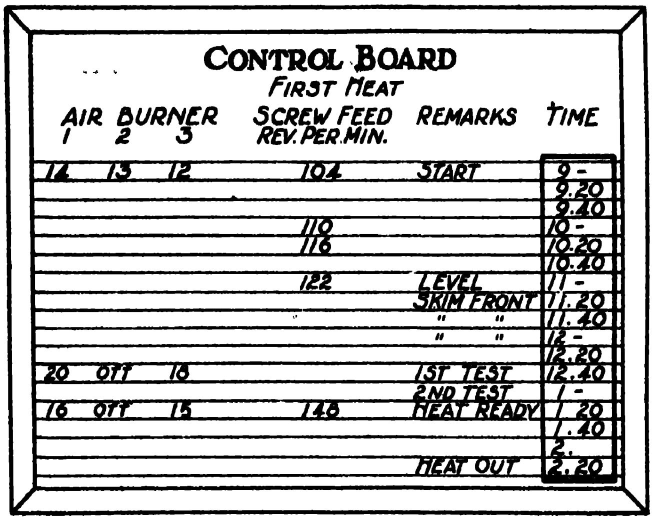


FIG. 4—DETAILS OF THE CONTROL BOARD DESIGNED AS A GUIDE FOR THE MELTER

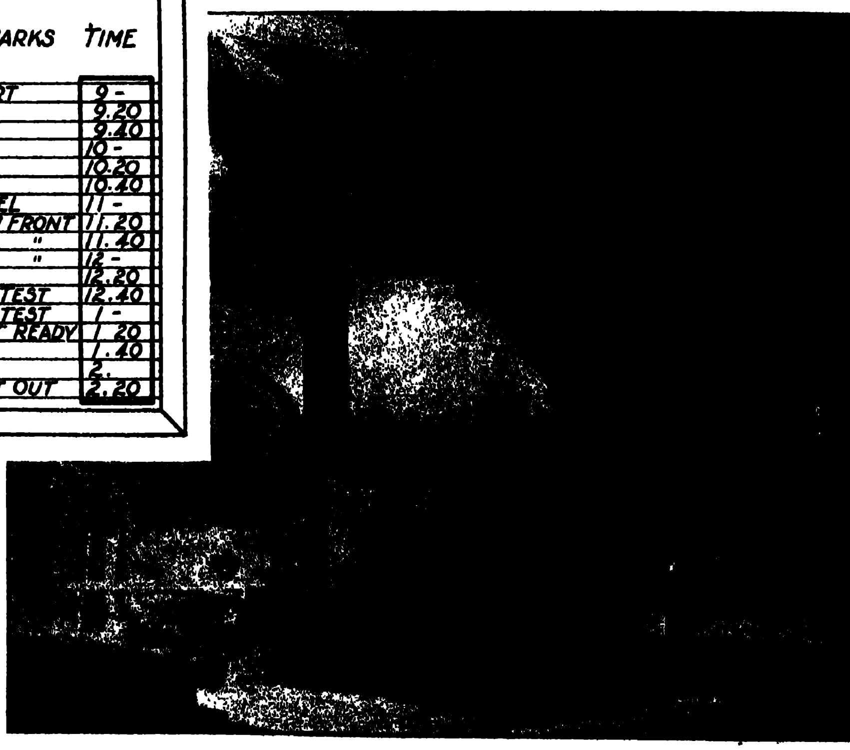


FIG. 5—POWDERED-COAL BURNING EQUIPMENT USED WITH A MALLEABLE-IRON AIR FURNACE

Castings For Ship Construction—XX

To Conserve Floor Space it is Recommended That a Pit be Bricked up in the Floor Corresponding in Shape to the Required Casting— Contraction Problems Discussed

BY BEN SHAW AND JAMES EDGAR

THE type of frame shown in the accompanying illustrations is the customary design for large vessels. It is one which presents unusual difficulties and one in which more than ordinary skill and judgment are called into play to produce a sound casting. Making the frame in two sections and afterward securing it by means of a scarph joint simplifies the molding to a certain extent and also aids the foundryman when providing methods to allow contraction of the casting to take place after the metal has become solidified. The shrinkage feature in large work of this kind is one of the most important problems to be considered and, as a rule, each job supplies a problem which requires individual solution. The intervening stiffeners are mainly responsible for these difficulties, because they offer an obstruction during the period of shrinkage and contraction. However weak the composition of the drawbacks may be, to allow the crushing action to take place, they must be strong enough to withstand the rush and pressure of the metal while the mold is filling. The length of the base part of the frame to which the keel plate is attached is approximately 40 feet, and the allowance for shrinkage would therefore be about 5 inches, varying with the composition of the metal used.

Providing for Contraction

It obviously is necessary when preparing the mold to provide some means which will allow for ready and uninterrupted contraction. The wedge method which is capable of so many variations, is very useful in such an instance as this, and its successful application removes the need for crushing the drawbacks to the same degree. The usefulness of the method is increased when there is comparatively little change in the sectional shape, or when the change is distributed gradually over a long length of the casting.

Owing to the size of flasks which would be necessary, the great length of the job leaves no other alternative to bedding in the floor. When making long narrow work of this character it is an advantage to limit the area taken up on the foundry floor, to facilitate drying and reduce labor. A good plan is to brick up the walls of a pit following the contour of the job to be molded, and dig out a depth slightly below the joint of the bottom drawback. Sometimes this brickwork is tapered and faced off in places with facing sand to form a side joint for the drawbacks; or the brickwork may be vertical, and a coating of sand applied to give the necessary taper. In a third method the drawback joints are made up well inside of the brickwork, in which case a larger area will be required in the foundry floor. In exceptional cases it may be considered advisable to form the back of the drawbacks against cast iron plates resting against supports carried by the girds. When this method is adopted there is clearance between the brickwork and the drawback which usually is loosely rammed prior to pouring the casting. This last method is advantageous when it is necessary to ease the mold directly after casting the metal, since the backing plates of the drawbacks then can be removed giving access to the inside.

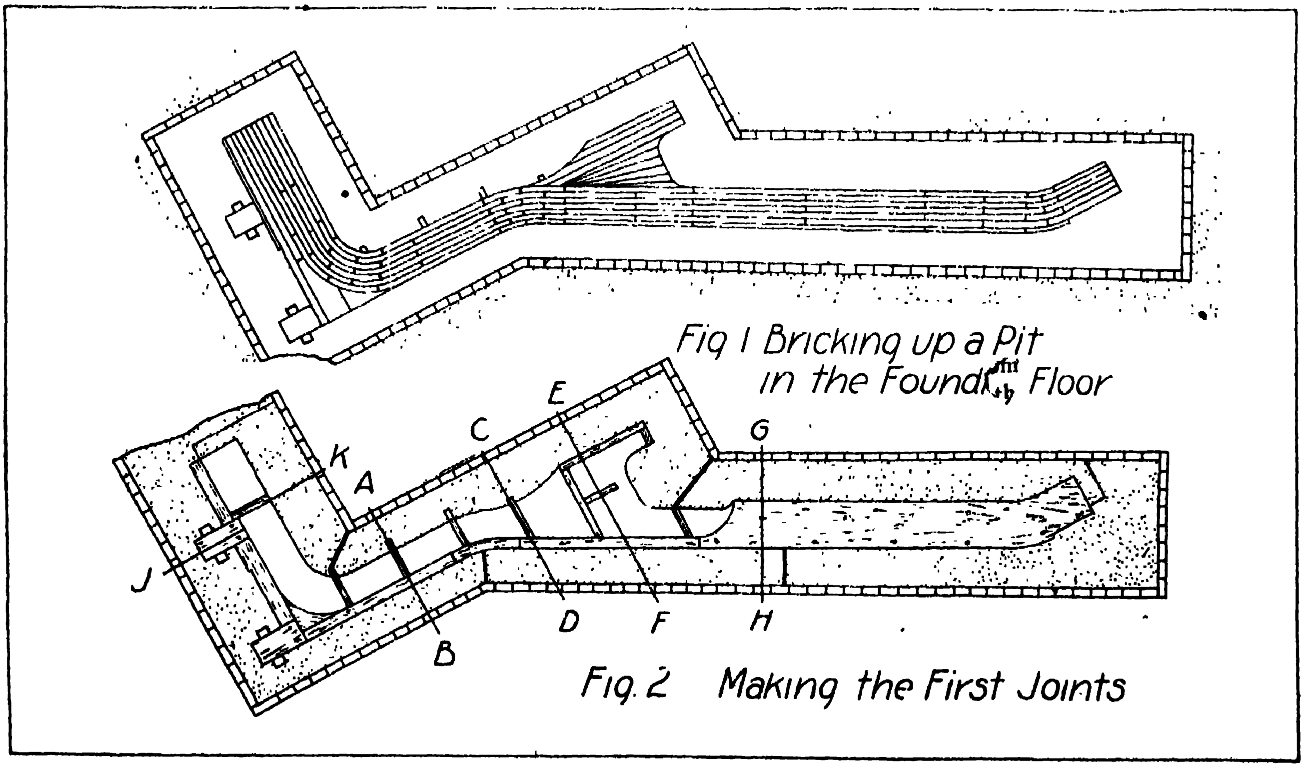


FIG. 1—A TEMPORARY PIT BRICKED UP IN THE FOUNDRY FLOOR FIG. 2—THE PATTERN AND PIT AFTER THE FIRST JOINT IS MADE

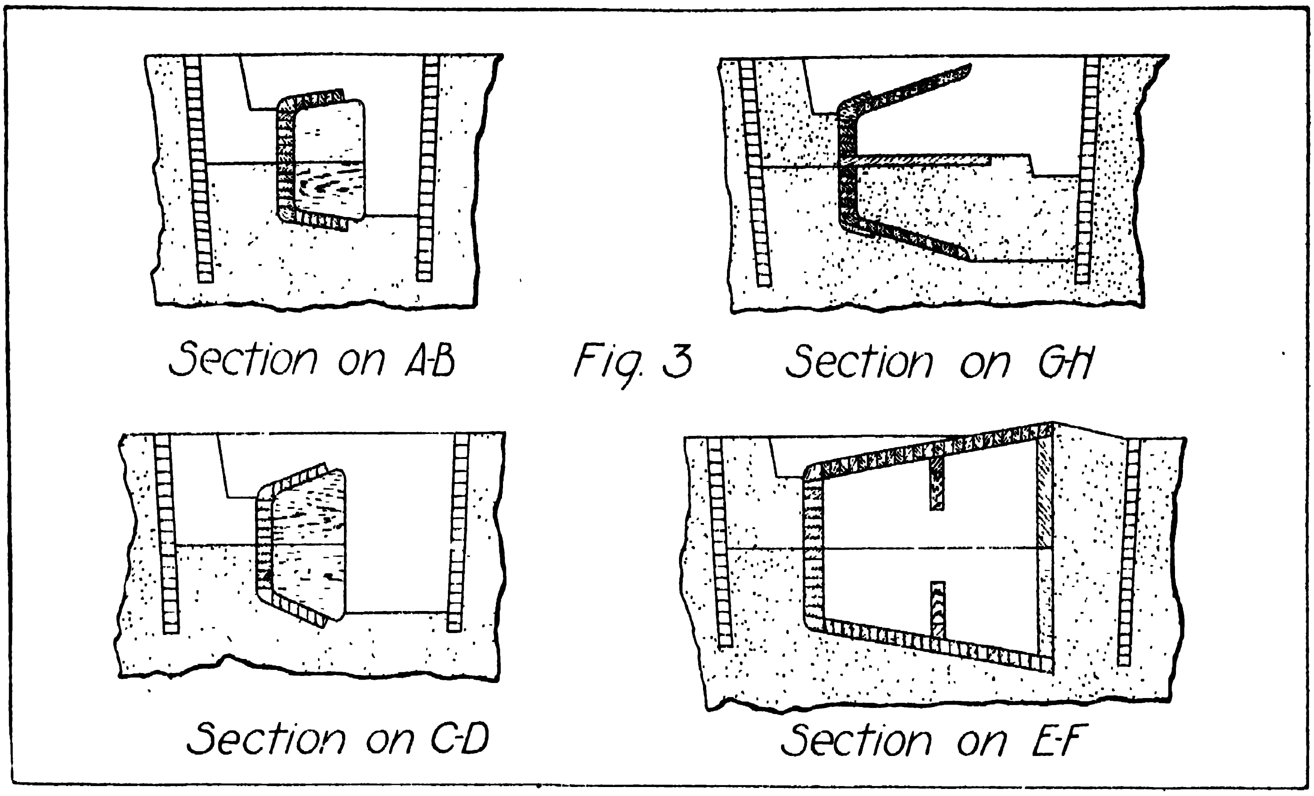


FIG. 3—SECTIONS TAKEN AT VARIOUS POINTS ON THE PATTERN SHOWING THE PARTINGS AND SHAPE OF DRAWBACKS NECESSARY

The illustration, shown in Fig. 1, gives the approximate shape of the brickwork which is found useful in making the frame indicated. The half pattern is laid upon the foundry floor as shown and the outline marked in the sand. Then the sand is removed, until a hole deep enough to take the full depth of the work is formed. Though the pattern as constructed is comparatively strong, its length tends to create difficulties in handling, hence considerable care must be exercised in bedding in the bottom half. Supports or jigs should be used at each end, fitting over the sectional shape and coinciding with the joint of the pattern. These assist in maintaining the true alignment of the work. During the process of ramming the sand under and around the half pattern the level should be kept in constant use. The quickest method of leveling the pattern is to build up a number of

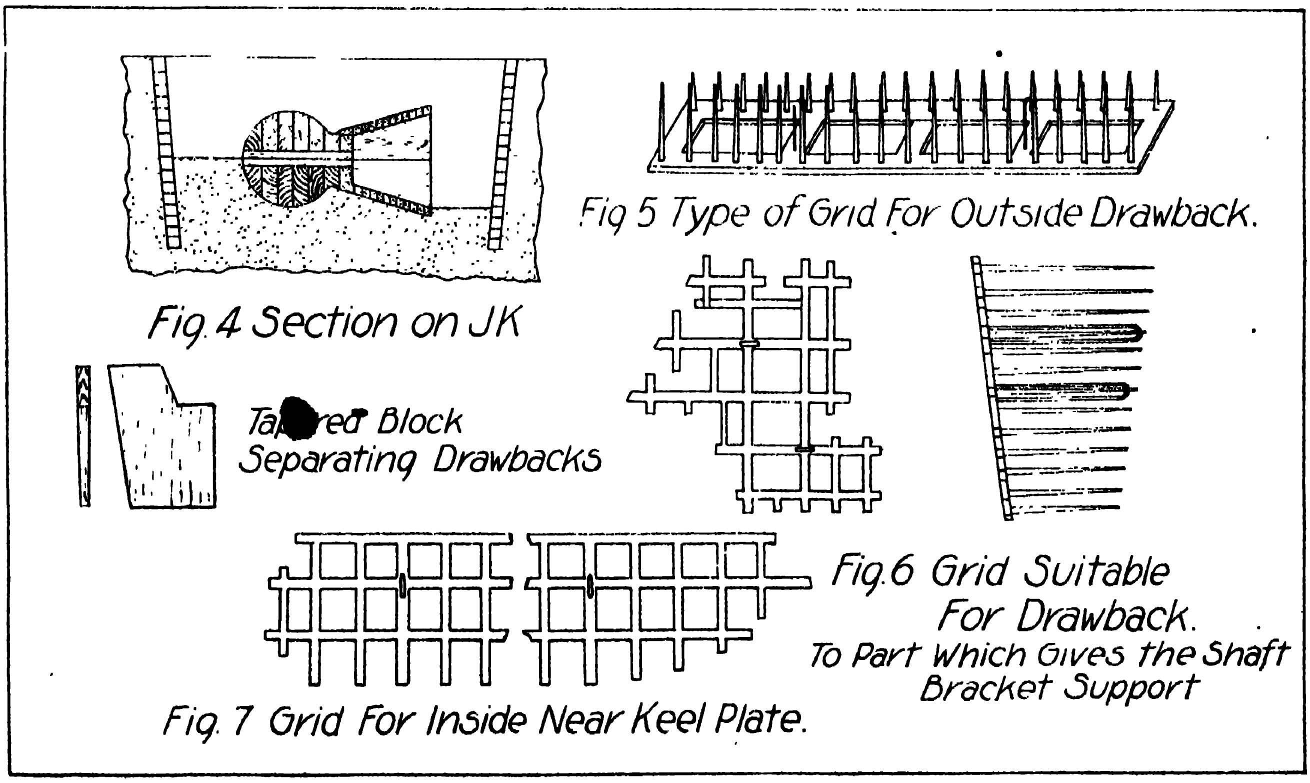
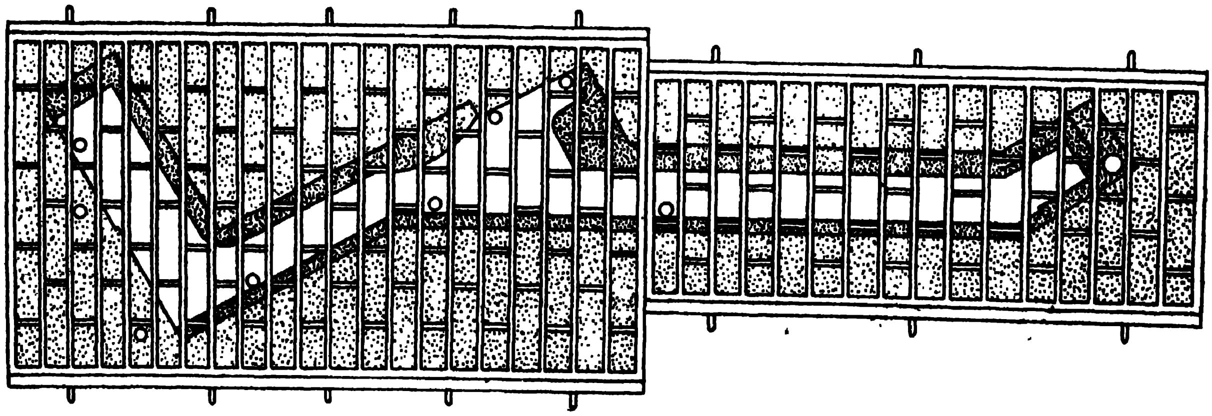
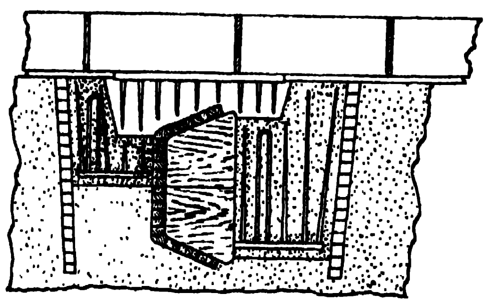


FIG. 4—SECTION AT *J K* FIG. 3 FIG. 5—GRID FOR OUTSIDE DRAWBACKS FIG. 6—DRAWBACK GRID FOR SHAFT BRACKET SUPPORT FIG. 7 GRID FOR INSIDE NEAR KEEL PLATE

bearings with the pattern in position, constantly trying with the level to get the right setting. When these resting places have been formed the pattern should be lifted to remove the bottom screws by which the stiffeners are secured, leaving the side screws in to maintain their positions. The pattern having been returned to its former position can then be rammed up, all the screws holding the loose pieces being removed just prior to the final ramming up and after the main section of the pattern has been bottom part of the pattern without disturbing the mold to any appreciable extent. When the pattern is very short it can be more easily handled and remains in a more rigid condition, and outside drawbacks need not be used. The plan view of the half pattern rammed up to the first joint is shown in Fig. 2. During the time of ramming the outside, wedge shape pieces of wood are set in the sand as indicated by the heavy lines on Fig. 2. These pieces should be carried the full height of the work, inner drawbacks are shown in Figs. 6 and 7, the former being a convenient form for the bracket section shown in *EF* of Fig. 3, and the latter a type used for the drawback near the keel plate end, shown by section *GH* in Fig. 3. This drawback is more conveniently made in two pieces, hence the first piece can be completed and the joint made for the upper one before the top section of the pattern is placed. When the work has advanced sufficiently and the full pattern is set, the outside drawbacks can be





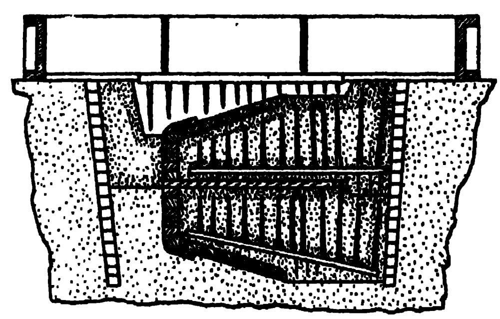


FIG. 8—SHOWING THE MOLD COVERED BY TWO SEPARATE COPES FIG. 9—TYPICAL SECTION SHOWING DRAWBACKS IN POSITION FIG. 10—THE DRAWBACK OVER HORIZONTAL RIB IS MADE IN TWO SECTIONS

well set. The supports at the ends can be removed and their impressions filled in with facing sand.

When the pattern is definitely set, arrangements may be made for jointing the mold. There are a number of ways by which this can be done, the method shown in this article being that most commonly practiced. Owing to the great length of the pattern it is necessary to form a joint along the outside coinciding with the joint of the pattern and on the inside the joint is formed to follow the contour of the inside of the web of the channel section. It is necessary to keep the first joints as far down as possible to allow the free withdrawal of the being cut at the joints for convenience in working. The impressions left by these wedges are filled with grids or plates carrying a coating of molding sand to give the desired shape. The various sections shown in Figs. 3 and 4 illustrate the joints in their relation to the bottom half of the pattern. Before the top half of the pattern is set the channel drawbacks should be commenced in order that the grids to carry them may be set in position. These drawbacks are divided into convenient sizes and wedge pieces are prepared and placed as indicated in Fig. 2 while working up the bottom of the drawbacks.

Two forms of grids suitable for the proceeded with. There is not the same need for precaution in connection with shrinkage on the outside, and a different form of grid can be used to carry these drawbacks, the form shown in Fig. 5 fulfilling requirements.

All of the many screws connecting loose pieces must of necessity be removed during the process of ramming these drawbacks and steps must be taken to maintain the position of the bottom halves of the stiffening ribs. The building up of the inner drawbacks after the pattern is placed, requires more time since the composite must be tucked under the top web of the section. The joint follow-

ing the surface of the middle web shown in section *GH* Fig. 3, should be checked back as shown to form a guide for the top portion. It gives the added advantage of counter-balancing the projecting core and this together with the support given at the ends render chaplets unnecessary when closing the mold.

The joint is formed after both sides are worked up to the extreme points of the pattern, following the lines of the section, and keeping as near to the top surface as the curve on the outer edge will allow. A flat duce the top lift by forming parts of the cover as cores. This method is very often adopted, as besides dispensing with a quantity of tackle and reducing the possibility of a bad lift, it eliminates the possibility of crushing when fitting the mold together. When the lift can be taken conveniently with the cope flask, grids are frequently used to support the sand rather than a large number of gaggers. When such a method is adopted much of the ramming can be done before the cope flask is placed in position. Whichever method is parts should be lifted according to the direction in which such joints are tapered. Stakes or guides should be fixed for each flask used to insure accuracy for each setting. When convenient it is preferable to allow freedom of access to the wedge pieces through the cover flask, so that after the job is cast they can be removed without disturbing the cope appreciably.

The pouring of such a casting is best accomplished from one end, preferably the end to which the keel plate is attached. A large gate should

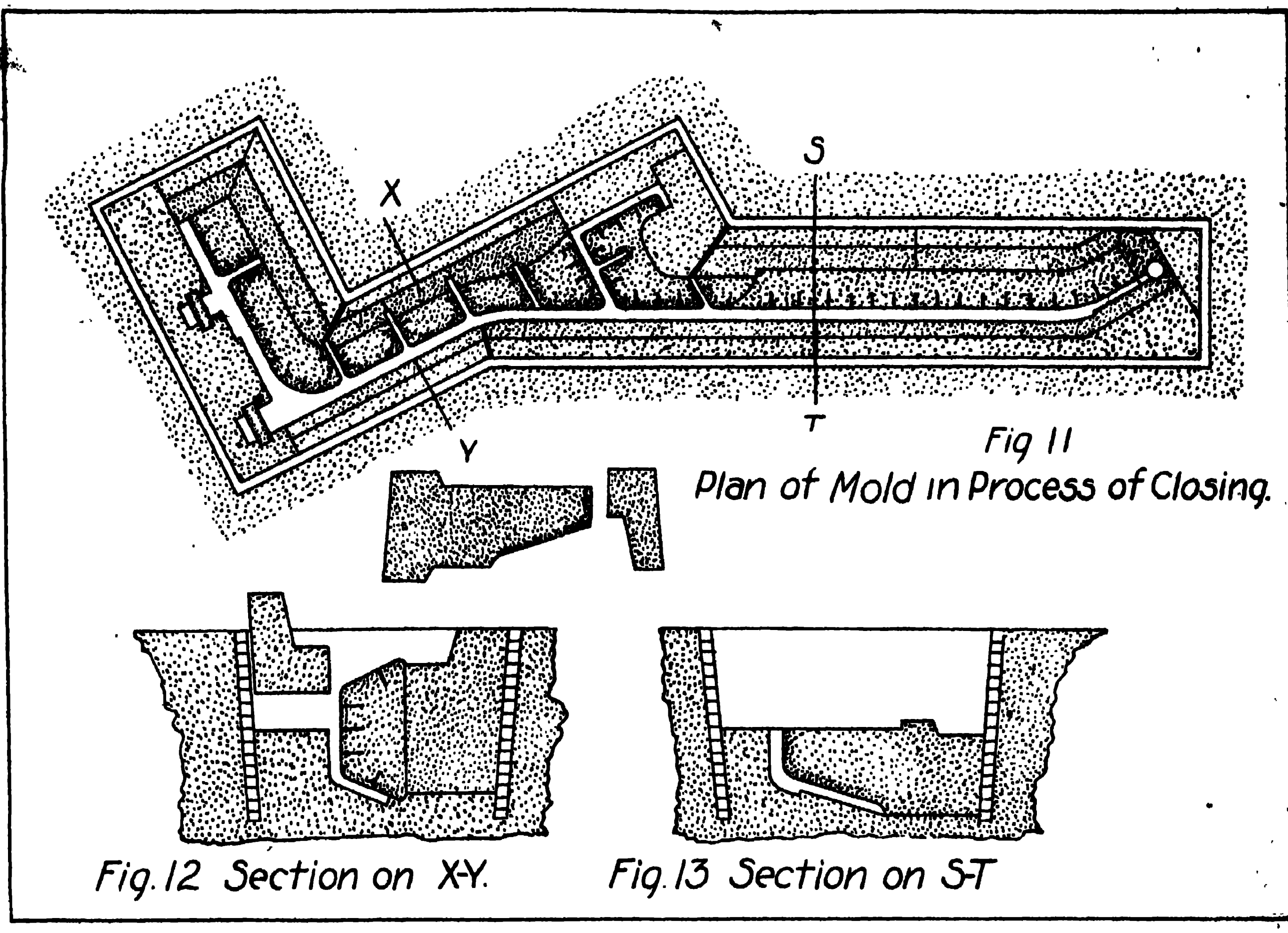


FIG. 11—PLAN OF MOLD PARTLY ASSEMBLED FOR CLOSING FIG. 12—SECTION AT *X Y* FIG. 13—SECTION AT *S T*.

bearing is provided parallel to the first joint, and then gradually tapered up to a levelled surface flush with the foundry floor and with the top of the brick wall of the pit. The general formation of these joints is more clearly indicated in Figs. 9 and 10. The top will not show a varying depth from the levelled surface, being least around the bracket for carrying the palms of the propeller shaft bracket, and greater near the rudder post connection.

It is sometimes quite a difficult proposition to carry the cover for the whole in the top flask because of the bulk of hanging sand. Under such circumstances it is preferable to re- adopted, however, the cope must be tried on so that the position of the runners and risers may be determined and provision made accordingly for the requisite clearance between flask bars. In Fig. 8 a method is shown whereby two flasks are used end to end to make up the necessary length of the job. It is quite usual in dealing with such long work to make use of a number of flasks for the cope, the kind and character of stock flasks determining the number required. The number used should be as few as possible, consistent with lifting facilities.

The sand joint between the parts should be tapered one way and the be carried the full depth of the work at the joint indicated on Fig. 8, so that a runner may be formed the full depth of the bottom of the channel section and against the drawback. The position of suitable risers is also shown in the same illustration. When the position of the cope flasks has been determined they can be removed until the grids are rammed. The relation between drag and cope, with the grids of the drawbacks more clearly defined is shown in Figs. 9 and 10. These illustrations also show the type of grid, with gaggers, useful for taking the top lift. They may be either secured to the cope flasks or used in strengthening separate bodies of sand

to form covering drawbacks. With the cover grids set and the whole tap rammed up, with gates and risers in position, the cope flasks may be replaced and the whole rammed up. When the flasks lend themselves to the removal of the wedge pieces, covering blocks of wood can be set between the flask bars to correspond to the position of the wedges. After the job is cast these blocks may be removed in order to give ready access to the wedges which may be hooked to a crane and withdrawn with little difficulty.

Having completed the ramming, the process of stripping can be proceeded the palm bracket with them. Considerable floor space is required for housing these drawbacks, and they should be placed as conveniently as possible for working. When all drawbacks are withdrawn, the lower shell of the pattern is practically free, and can be lifted fairly easily. It is advisable however to use a long bar for this purpose, in order to keep the pattern as straight as possible to clear the mold. When the various parts of the pattern have been drawn out of the mold, the process of nailing, slicking and generally cleaning up of the mold and drawbacks is begun. Considerable care must be exercised so that they will follow the heavy lines shown in Fig. 11 and conform with the joint for the cope. The wood wedges used in preparing the mold are usually used to form these cores. The mold drawbacks and cores after being painted where the metal is to come in contact with them are again thoroughly dried before fitting.

An illustration of the mold having some of the drawbacks in position is shown on Fig. 11. Sectional elevations are shown in Figs. 12 and 13, illustrating the relative positions of the drawbacks with the mold. When the work is satisfactorily fitted together, and the wedge cores lowered

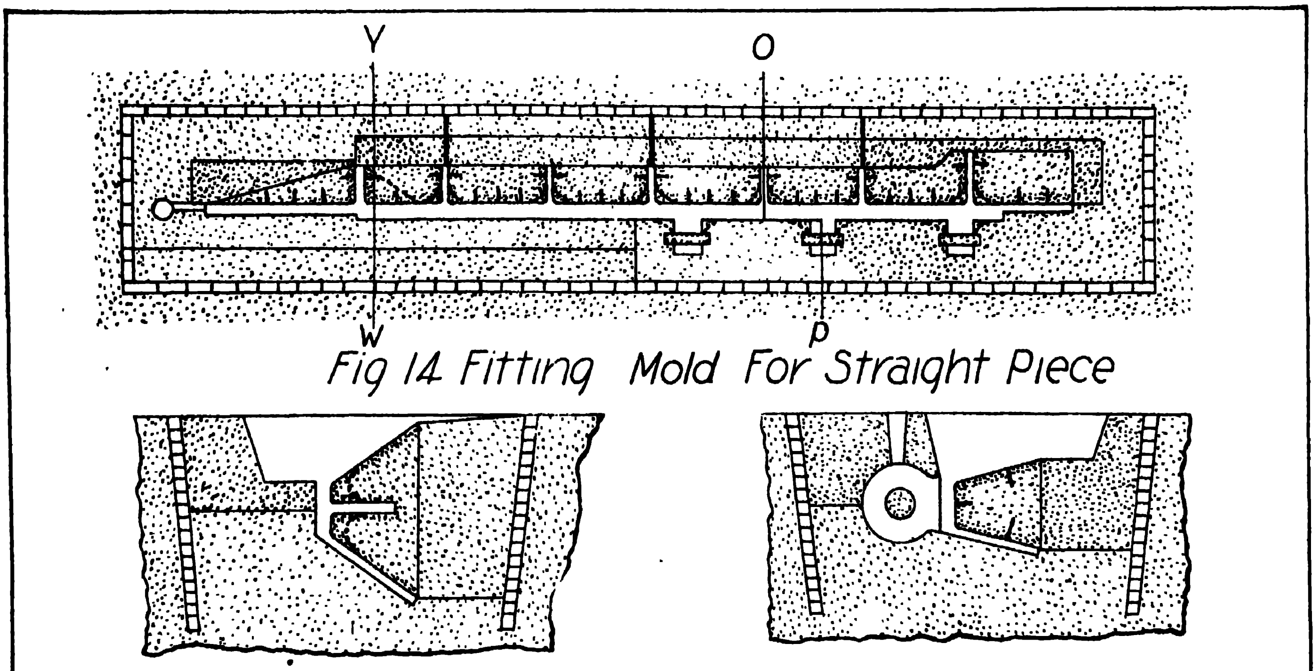


Fig 14 Fitting Mold For Straight Piece

Fig. 15 Section on Y-W

Fig. 16 Section on O-P

FIG. 14—FINISHED MOLD PARTLY ASSEMBLED FOR STRAIGHT PIECE FIG. 15—SECTION AT Y W FIG. 16—SECTION AT O P

with. The cope flasks are removed, and if the lift is small due to using cores, they may be turned over for convenience in working. If, however, the full lift is taken with the cope flasks it is rather a precarious undertaking to roll them over, hence they are usually set on supports and all finishing work done from underneath. The outside drawbacks should be removed first and when the screws into the ribs are removed the top section of the pattern is clear and can be removed. The top drawback covering the horizontal web is next lifted, and the web unscrewed from the lower half of the pattern. The wedge pieces can be withdrawn and then all the inside drawbacks can be lifted in their turn. They will of course carry the stiffening ribs and webs around in the work to insure as clean a casting as possible.

A large number of thin contraction webs require to be cut connecting the ribs with the sides of the channel section and at all points where they will assist in preventing fracture during the time of solidification. The drawbacks being of convenient size can be removed to an oven for drying, the rest of the mold being dried in place. The brickwork surrounding the mold is an advantage after the job has been dried since it prevents the moisture being absorbed from the surrounding floor sand to any considerable extent. The cores required for this mold are the simple straight cores for the gudgeon pins and the wedge pieces for separating the drawbacks, the latter require to be shaped into their respective places, the cope flasks can be replaced and the usual arrangements made for runners and risers. When the head troughs or basins are grouted to the cope and the boxes weighted the mold is ready for casting.

In all castings of this character the easing is of vital importance. All risers must be well cleared and the wedge pieces withdrawn if possible before the removal of the cope flasks so that the drawbacks may move along with the casting to a certain extent and relieve the strain at important points. Lengths of chain, rammed into the sand at critical places and carried to convenient points where they can be pulled out with a crane, are invaluable for weakening the sand. Such a method could be

adopted between the projections for the gudgeon pins.

The same method is adopted for preparing the mold for the other section of the frame. The channel section is almost parallel in this instance, hence the removal of the wedge pieces allows the inner drawbacks to be carried along with the casting while the metal is contracting, relieving it of much of the strain when taking its final shape. A plan of the

opinions prevail respecting the best time for removing castings to the annealing ovens. Some foundrymen say the casting should be allowed to become quite cold before it is moved from its mold. Others believe that it should be put into the oven as soon after the metal is poured as is consistent with safety and while the casting retains considerable of its original heat. It is our experience that the majority of steel castings can be

years ago it was unable to establish the company in New York state under the original name, because of a previously organized New York corporation having the same name. Therefore it was called the Cleveland Osborn Co. Later the Ohio charter was amended to take the same name. The company recently has acquired the charter of the New York corporation and arranged to have the business restored to its former name

Authors Outline Technique of Ship Castings Art

THIS article concludes the series on the general practice adopted in patternmaking and molding steel ship castings. Differences of opinion exist among foundrymen respecting the best procedure for the varying types of work. Different countries have different methods in applying the principles involved in securing sound castings, and it is rarely indeed that any two foundries even in the same country adopt exactly similar methods. No foundry has a monopoly on the best ideas for turning out all kinds of perfect castings economically. One of the best means of bringing about uniformity in the preparation of molds is through the technical press, and the means employed, with special regard to ship castings practice have been considerably neglected in this respect. Circulating descriptions of methods which have proved successful tend to influence the average foundryman and incidentally increase production.

Many factors must be taken into consideration with regard to the construction of the patterns. Some foundries have plant and tackle suitable for handling pattern which nearly represent the finished casting. Others prepare special core floors to reduce the molding space and are fitted to cope with block patterns having separate cores. The local system of payment may influence the foundry executive to prefer the latter method. The work may be divided among a greater number of men and more rapid production secured. It is usual for the patternshop to prepare the patterns according to the system in vogue in the foundry likely to undertake the work. Good patterns are essential to the steel founder, as the nature of the sand forming the face of the mold does not lend itself to patching as readily as that employed in molds for cast iron. Quite apart from the fact that the steel molders require a good pattern, the nature of the castings, especially those used in connection with ship construction, make it imperative that a strong pattern be supplied, having the rigidity likely to produce a true casting.

While these articles have been mainly concerned with the construction of typical patterns and the preparation of the molds, the character and composition of the sand used and the temperature and quality of the metal when poured are of equal importance in the production of sound castings. While a good sand possessing the necessary cohesiveness and sufficiently refractory to withstand the high temperature of the metal is necessary, the human factor is equally important. Finding the best means of preparing the mold so that shrinkage and contraction difficulties are reduced to a minimum, seeing that runners and risers are provided in such a manner as experience has proved to be most successful, building up the mold for convenience in separating and reassembling before and after the pattern is removed, all have much to do with producing satisfactory castings.

Many castings are lost through lack of caution when annealing. Whether the casting to be annealed is packed in the furnace hot or cold, the temperature of the furnace should be approximately that of the work and care must be exercised in packing the casting to give the necessary support without interfering with its free movement as the temperature is increased or reduced. The furnace should be heated up gradually, the temperature and the duration of the heat depending largely upon the character of the work. If it is necessary to raise the temperature gradually, it is, if anything more essential that it should be reduced gradually.

mold partly closed is shown in Fig. 14. The lines of the joint and two sectional elevations are depicted in Figs. 15 and 16. These show the relative positions of the drawbacks in the mold. The cope flasks, which may number two or three, are comparatively narrow in this case and when the castings are molded in the manner indicated previously, take up less room on the foundry floor than when no brickwork is used to form a pit. The same precautions used to ease the first casting must be observed with this one, and both castings require to be annealed. Different

moved while they are hot. No ill effect will follow and fuel consumption is reduced, provided the temperature of the oven is about the same as the castings and ordinary precautions are taken while they are being moved from the floor to the oven.

Machine Company Resumes Old Name

The name of the Cleveland Osborn Mfg. Co. recently has been changed to the Osborn Mfg. Co. When the Osborn Mfg. Co., Cleveland, established a New York branch several

by which it had been known since 1892. The capital stock of the company was increased to $2,000,000 and the capacity of the plant doubled in 1919.

Besides the main office and factory situated at 5401 Hamilton avenue, Cleveland, the company maintains offices and warehouses in New York, Detroit, San Francisco, Milwaukee and Chicago. The company's molding machines are handled in France and Italy by the Allied Machinery Co., of America; in Belgium by Isbecque & Co.; and in England by J. W. Jackman & Co.

Ohio Company Starts Steel Foundry

Castings Will be Furnished to Enable the Parent Company to Build Rolling Mill Equipment—Open-Hearth Situated at One End of the Main Bay Facilitates Straight-Line Production

BEFORE starting a new enterprise or extending an established one, a comprehensive study usually is made in order to analyze the various factors bearing on the problem. Data secured in this manner are used as a premise upon which to base estimates of probable future needs. Considering the present abnormal cost of materials and labor for construction, the future must appear unusually bright to the manufacturer who contemplates increased plant capacity or facilities at this time. This is true to even a greater degree when a new field of business is entered or a new product is to be manufactured.

That the reward for enterprise apparently far more than compensates for the high cost and unusual difficulties of present day construction is well emphasized by the number of conservative firms which recently have constructed plant additions or are contemplating expansion of existing facilities. One of these is the Alliance Machine Co., Alliance, O., which about a year ago, decided to increase its facilities so that it would be in a position to compete for orders for rolling mill equipment. A rolling mill department was organized with C. N. Resse as engineer in charge of rolling mill design. One of the first questions to arise was that of providing an adequate supply of stee' castings and in order to solve this problem the Machined Steel Castings Co. was formed. The company not only will make all the steel castings for the Alliance Machine Co., but also will do a general jobbing business. The latter company also is closely affiliated with the Alliance Structural Co. which is engaged in erecting work. The close relations existing between the three associated companies affords the Alliance Machine Co. an unusually good opportunity to produce rolling mill equipment.

Work on the main building of the Machined Steel Castings Co. was started June 16, 1919, and the first heat was poured Dec. 24. The plant is situated on a 17-acre plot of land on the east side of Mahoning avenue, Alliance, which divides Stark and Mahoning counties, the works being

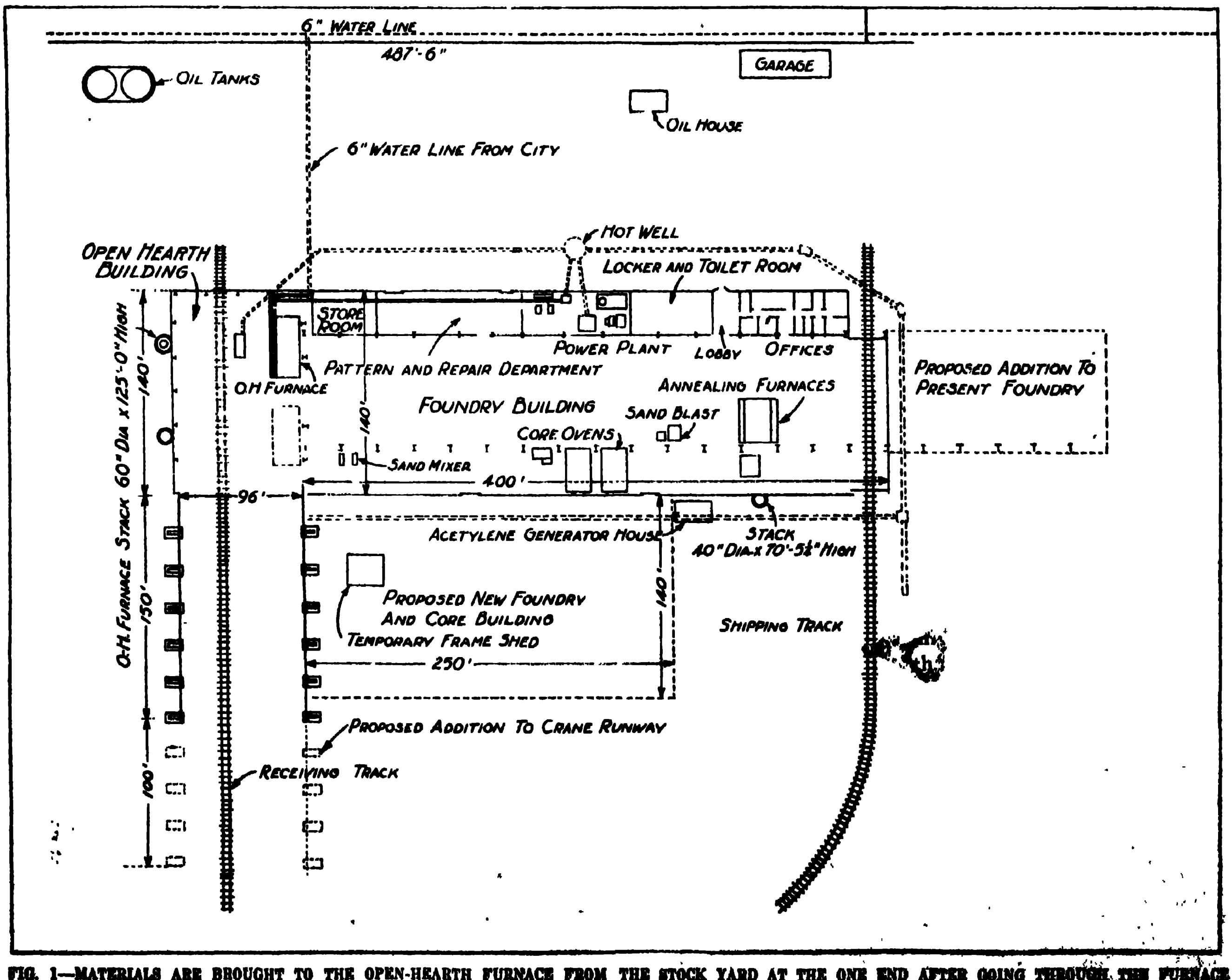


FIG. 1—MATERIALS ARE BROUGHT TO THE OPEN-HEARTH FURNACE FROM THE STOCK YARD AT THE ONE END AFTER GOING THROUGH THE FURNACE THE STEEL IS POURED INTO MOLDS ON THE FLOOR FROM WHENCE IT TRAVELS ALONG A STRAIGHT LINE PAST THE CLEANING AND ANNEALING DEPARTMENTS TO THE SHIPPING TRACK

FIG. 2—THE STOCK BAY LIES AT RIGHT ANGLES TO THE MOLDING FLOOR—PIG IRON AND SCRAP STEEL ARE BROUGHT TO THE CHARGING PLATFORM BY THE YARD CRANE WHICH TRAVELS IN FRONT OF THE FURNACES

in Mahoning county outside of the city limits. The plant is served by railroad sidings connecting with the Cleveland and Pittsburgh branch of the Pennsylvania railroad. Much of the acreage is low and will afford ample dumping ground for many years.

As shown in Fig. 1, one of the railroad spurs extends through the stockyard to the charging platform of the open-hearth department. The yard is commanded by a 15-ton crane running on a 90-foot runway extending across the charging floor. By the use of magnets and grab buckets the crane unloads pig iron and scrap and carries them in standard shaped charging buckets to the charging floor where they are set on flat bottomed cars on the track paralleling the front of the furnace. Sand also is handled by this crane. A general exterior view of the building showing the crane runway and the stockyard is shown in Fig. 2.

The acid-lined 25-ton open-hearth furnace, shown in Fig. 3, was designed and built by the company. The doors and front plates are water cooled so that they will not buckle from the heat within.

As a means of contributing to the comfort of the workmen the sash in the wall of the building at the rear of the furnace are removable. These sash, together with those between the charging floor and stock bay, are removed during the summer months to allow air to circulate freely, over the platform and through the monitor in the roof.

The materials are charged into the furnace by a 5-ton charging machine, shown in Fig, 3, which was built by the Alliance Machine Co. This machine moves along the tracks as shown in the illustration and pushes the cars with the charge boxes by engaging them with the head of its ram. The furnace doors are controlled by means of large hand wheels shown in Fig. 3, which are geared low and can be handled without difficulty by one man. The valves also are operated from the same point.

In charging the furnaces a small

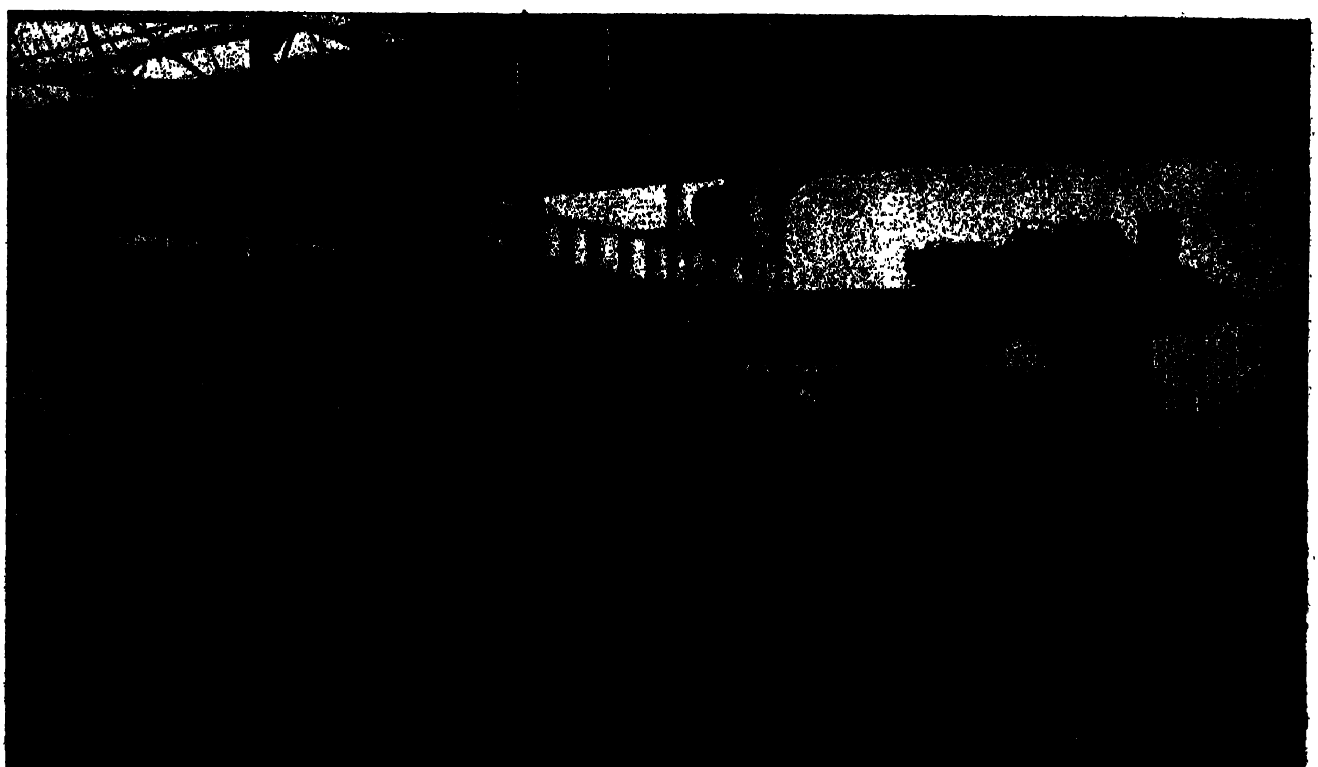


FIG. 3—SECURITY AGAINST BUCKLING IS PROVIDED BY WATER COOLING BOTH THE DOORS AND THE FRONT PLATES OF THE FURNACE—MANGANESE IS ADDED TO THE STEEL IN THE FURNACE INSTEAD OF IN THE LADLE

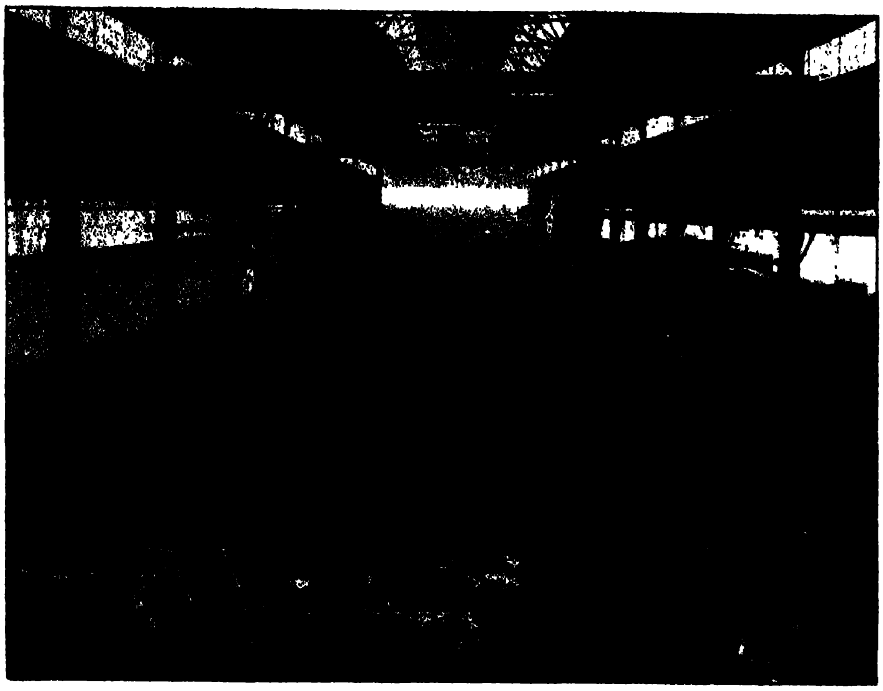


FIG. 4 FROM THE PLATFORM IN FRONT OF THE OPEN-HEARTH DEPARTMENT WORK IN THE ENTIRE FOUNDRY MAY BE SEEN NOTE THE TWO SIDE BAYS

amount of scrap is placed on the bottom, after which the pig iron is charged and the remainder of the scrap is added. When these materials have been melted the carbon content of the mass is reduced to the proper amount by adding iron ore. After the boil is finished and the carbon content is shown by fracture test to be sufficiently low, 10 per cent ferrosilicon is added. A quantity of this material is shown at the right in Fig. 3. The ferrosilicon is placed directly inside of the three charging doors by the use of a peel The doors then are closed until the pig has a chance to heat after which they are again raised and the metal is pushed into the bath. The ferromanganese, also shown in Fig. 3, is thrown into the furnace through all three of the doors. The bath is then stirred with long steel bars extending through the peep holes of the doors A small amount of manganese is also added in the ladle as the heat is tapped, but this addition is only a fraction of the amount used in the furnace. Additions are made in the furnace because it is thought that the manganese mixes more uniformly with the steel, but there is a greater loss of the alloy than when it is added in the ladle.

When the metal is tapped into the ladle it is carried by crane to the molding floors in the main bay. This part of the building is 400 feet long and has a runway 75 feet wide. Practically all of the foundry work is performed in this bay. At present two cranes are operating in this section of the building. One is of 30-ton capacity with a 10-ton auxiliary hoist and the other is of 15-ton capacity. These, as well as all other cranes in the plant, were made by the Alliance Machine Co. As shown in Fig. 4, the main bay is flanked on either side by a 30-foot side bay, the one on the left being partitioned into various rooms and that on the right forming an extension to the main bay.

After sand is brought into the building from the stock bay it is delivered to a sand mixer of the muller type situated in the end of the side bay toward the open-hearth furnace. At present the sand is being carried in wheelbarrows but a conveying system is to be installed. The mixed sand is carried to the molding floors in boxes handled by the cranes.

The core and drying ovens are situated about half way along the side bay as indicated in Fig. 4. The ovens were built by the Ohio Blower Co., Cleveland. A novel feature of the core oven trucks is the design of the bearings. As shown in Fig. 8 each truck is supported on two axles, the wheels being shrunk onto the axles. The journals rest in U-shaped bearings which are of such dimensions that the axle is loose and moves from one side of the U to the other when the direction of the truck is changed The core department also is in the side bay next to the mold drying ovens. This department is served by a 3-ton crane which handles sand and moves some of the larger cores.

The sand blast equipment, which is located near the shipping department, consists of a revolving barrel and a sand blasting chamber built by the Pangborn Corp., Hagerstown, Md. The installation of this equipment is shown in Fig. 7. The roof of the sand blast room has a long narrow opening, closed by a door when desired, which allows the chain of the crane to enter when large castings are being handled.

The annealing pit, shown in Fig. 6, was designed and built by the company. It is 25 feet long, 15 feet wide and 9 feet high to the base to the arch. Heat is provided by three oil

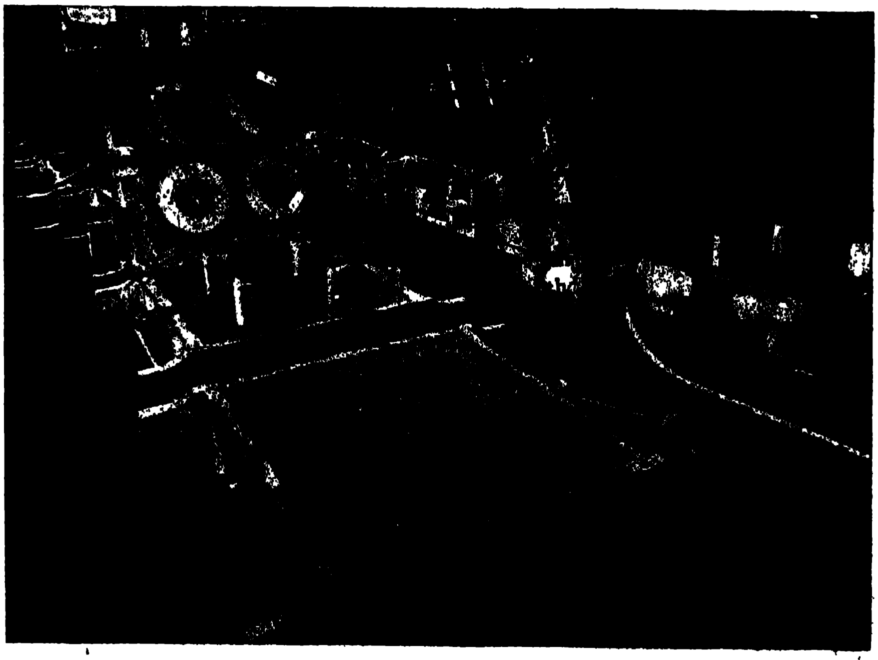


FIG. 5—SHAFT COUPLINGS ARE MADE IN GREEN SAND WITHOUT RISERS—THEY ARE CAST WITH THE FINISHED SIDE DOWN

burners on each side and near the bottom of the oven. The burners are accessible through a long narrow pit on each side. The top of the annealing pit is covered with large cast steel bungs lined with firebrick. The bungs are handled by the traveling crane and may be stacked one upon another, the projecting lugs at each corner preventing the brick work of the upper bung from touching the framework of the lower one. A furnace of this size requires a comparatively long time to heat, especially when filled to capacity with castings. In order to accommodate smaller castings and to reduce the heat required for annealing a smaller oven is being built. It is intended that this oven will be under heat practically all of the time. A charge can be quickly removed as soon as it becomes black and another charge can be put in the furnace before it becomes entirely cold. The castings will be charged through a door by means of a peel.

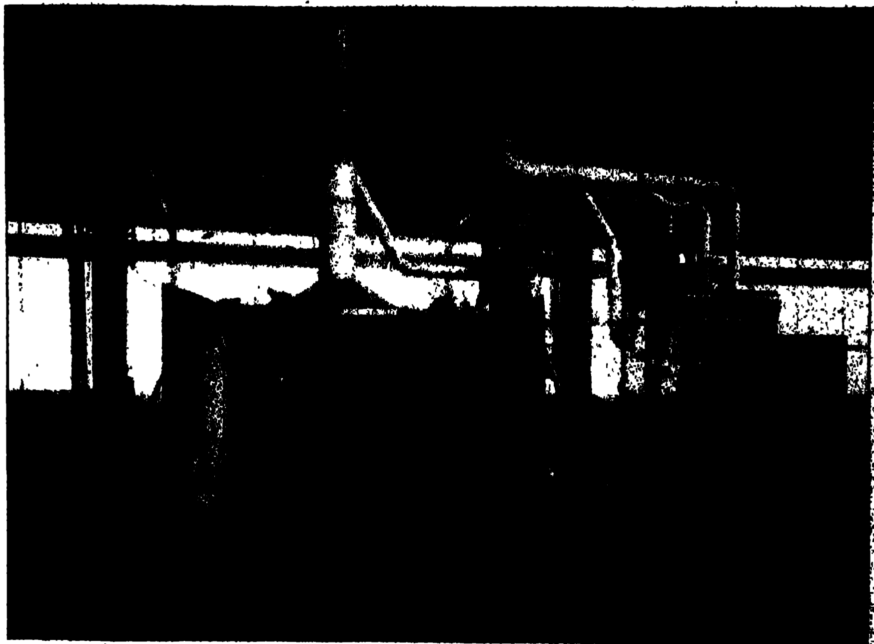


FIG. 7—CASTINGS ARE PLACED IN THE SANDBLAST ROOM BY THE CRANE—THE CHAIN PASSES THROUGH AN OPENING IN THE ROOF, WHICH IS CLOSED WITH A DOOR WHEN THE SANDBLAST IS OPERATED

In past years the Alliance Machine Co. has had considerable difficulty in securing an uninterrupted supply of shaft couplings, bearings and similar small castings. Therefore, one of the first acts of the new company was to equip the foundry for making castings of these kinds. Two floors of molds for shaft couplings are shown in Fig. 5. As shown in the illustration four patterns are mounted on match boards with set gates. Two molders work in conjunction with each other, one working on the drag and the other on the cope. When each man finishes his section of the mold, the patterns are exchanged and each then puts up the other half of the molds. When it is ready to be closed the molders help each other and in this way one complete pattern serves two molders. The molds are gated from the bottom, and the side of the casting which is to be machined is cast face down. This is thought to give a cleaner surface than would be obtained if it were cast face up. The molds are made in green sand and no riser is used.

Pneumatic Tools Cleaned Regularly

The side bay which is partitioned off from the main bay contains a store room, pattern shop, power plant and offices. The store room is at the end near the furnaces and contains the less bulky materials and the smaller tools used in the foundry. In addition to handling these articles the stockkeeper is in charge of the pneumatic tools. Each evening all pneumatically operated tools are turned in to this department where they are thoroughly cleaned with kerosene and oiled before they are issued again.

The pattern and repair department is in a room next to the store room. Comparatively new patterns are made but considerable work is done repairing old patterns and changing equipment to suit molding condition. The power plant which is adjacent to the pattern department contains equipment for converting electricity supplied by an outside power company. Two rotary converters change alternating current at 2200 volts to 250-volt direct current for use of the crane and grinder motors after voltage has been stepped down through three transformers. Three other transformers are employed to step down the current to 440 volts at which pressure it is used on motors requiring alternating current. Still another transformer changes the voltage to 110 for the lighting system. All of the electrical equipment was furnished by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The power plant also contains an air compressor with a capacity of 1300 cubic feet per minute built by the Ingersoll-Rand Co., New York. The heating equipment, also in this department, consists of an oil fired boiler furnished by the Erie City Iron Works, Erie, Pa., and a set of steam coils across which air is blown by a fan. The heated air is carried through

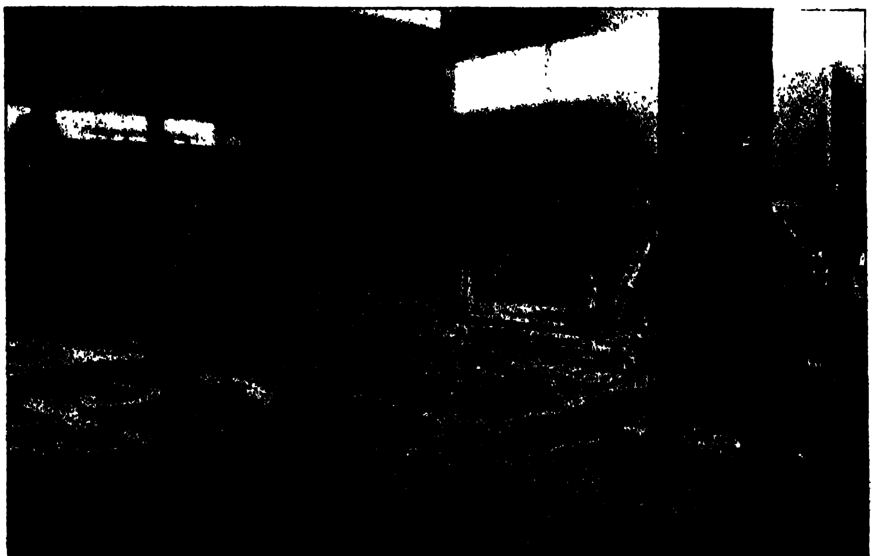


FIG. 6—OIL-FIRED ANNEALING PITS OF THE BUNG TYPE ARE USED—THE BURNERS ARE REACHED THROUGH A LONG NARROW PIT ON EACH SIDE OF THE OVEN

ducts into all parts of the foundry and discharges through pipes about 2 feet from the floor level. The ends of the pipe are covered with a distributor which causes the discharged air to spread out horizontally in a circle.

Part of the water supply, which is secured from the city mains, is used in the open-hearth furnaces for cooling purposes. Water from the furnace goes to the hot well, indicated in Fig. 1, from where a portion of it returns to mix with fresh water entering the open hearth. Fresh water also is used to cool the air compressor and is then sent to the hot well. The heated water from the hot well is injected into the steam boiler of the heating equipment thus saving the fuel which otherwise would be required to heat cold water as taken from the main.

The remaining space in the side bay is devoted to offices and locker and toilet rooms separated by a lobby in which the time clocks are located. Individual lockers have been provided for each workman so that he may have a place to keep clothing and personal belongings where it will be secure from interference.

A small brick structure outside of the main building has been erected for housing an acetylene generator and for storing oxygen tanks. Considerable acetylene and oxygen is used in the cleaning room for cutting the risers and heads from castings. In order to insure a continuous supply the acetylene is generated and a quantity of it stored while the oxygen is kept in the small tanks in which it is received. In order that the gas may be used uninterruptedly a special pipe system was installed. Twenty oxygen tanks are attached to the main supply pipe, which is divided into two compartments, 10 tanks being connected to each compartment. This arrangement making it possible to supply oxygen from one side while 10 fresh tanks are being coupled to the other side of the supply pipe. The acetylene equipment was supplied by the Davis-Bournonville Co., Jersey City, N. J. The welding equipment also includes an electric set manufactured by the Westinghouse Electric & Mfg. Co.

Fuel oil is stored outside of the main building in two underground 50,000-gallon tanks. Other oils, including kerosene and lubricating oil, are stored in a separate brick building, indicated in Fig. 1.

The capacity of the present equipment already has proved inadequate and a second 25-ton open-hearth furnace is being installed. A 30-ton and a 15-ton crane also have been ordered and will be erected in the main bay. The added furnace and crane facilities will enable the company to pour 60 tons of metal into one mold as each of the furnaces has enough capacity over the rated amount to enable each to melt 30 tons at a heat. The foundry now is engaged on an order for more than a million pounds of castings to be used in the construction of the sheet rolling mills which the Alliance Machine Co. is building for the plant for the Republic Iron & Steel Co., at Niles, O. This order requires 32 housings each of which weighs 34,000 pounds.

When the two open-hearth furnaces are working at capacity more foundry space will be required and this will be secured by extending the stockyard crane runway 100 feet, building a 140 x 250-foot addition at the side as indicated in Fig. 1, and extending the end of the foundry 150 feet, thus increasing the cleaning room space. When these additions are made the new bay will be used as a molding floor and the molds will pass through the drying ovens to the main bay, where they will be poured. At present only one shift of molders are working but it is intended to work two 8-hour shifts and to run the furnaces continuously.

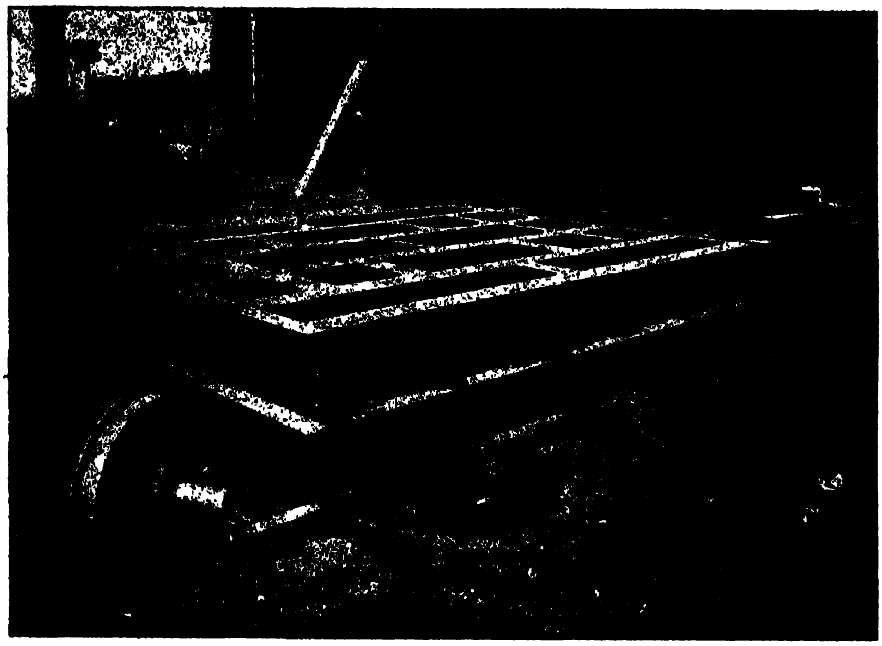


FIG. 8—A SLIDING BEARING ON THE DRYING-OVEN CARS IS AFFECTED BUT LITTLE BY THE HEAT—THE WHEELS ARE SHRUNK ON THE AXLE

Melting Iron With Powdered Coal

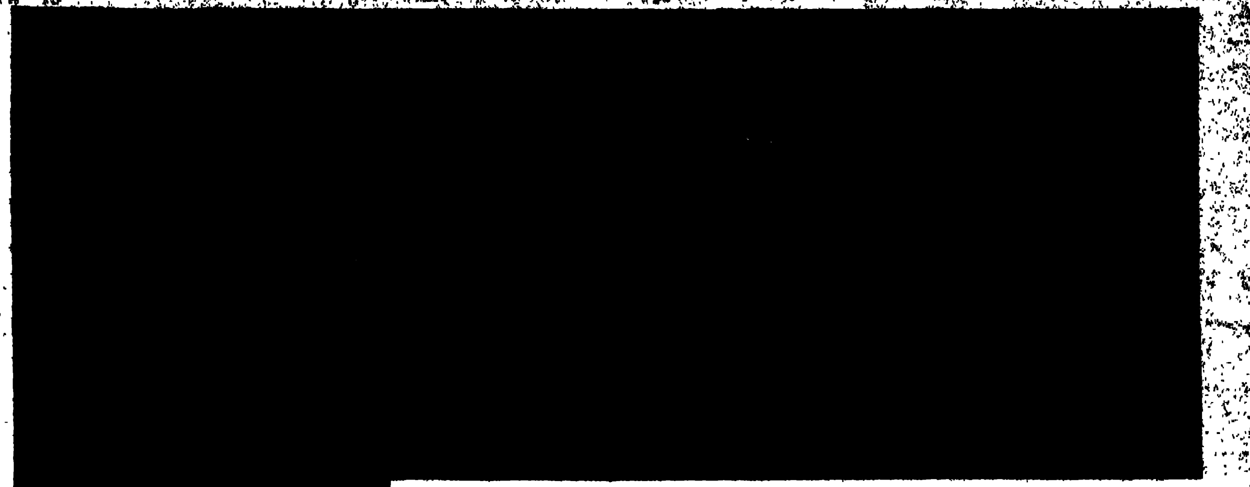
(*Concluded from page 139*)

separator to remove all metallic particles and dropped into a rotary kiln dryer. The inverted cone shown connected to the upper end of the dryer is a dust arrester which retains and separates the coal particles from the dust which is given off in the dryer. At the lower end of the dryer is an elevator which carries the dried coal upward and delivers it through a chute into the dry storage hopper. From this hopper it is fed into the pulverizer, from whence it is carried upward by air pressure and delivered through a second arrester to the storage hopper or tank. From this point the material is forced under air pressure to the supply hopper at the furnace much in the same manner as water is forced through delivery mains.

Company Desires Data

Fundicion y Talleres "La Union," 4056 Calle Corrientes, Buenos Aires, Argentina, South America, is constructing a new iron foundry, 120 x 200 feet, and also plans to extend its brass foundry. The company wishes to receive catalogs covering all classes of foundry equipment, and especially molding machines for light work.

The Ideal Furnace Co., main office Detroit, which has for years operated a furnace and boiler shop in Milan, Mich., has purchased the plant and foundry recently vacated by the Homer Furnace Co., Homer, Mich. The latter company has moved into a large new plant at Coldwater, Mich.



Brass Foundry Specializes in Plumbers' Fittings

By Pat Dwyer

WATER for internal and external use is one of the prime requisites for the maintenance of life. Seven-tenths of the human body is composed of water and owing to the changes and elimination constantly going on the supply must be replenished regularly. Under primitive conditions, a running stream or a pool of water were ample and fulfilled all requirements. However, where large numbers of people lived in the same community, these primitive facilities were totally inadequate and other systems had to be devised to supply sufficient water for household purposes. In the original community installations, stone aqueducts and hollow logs were employed to convey the water from its source of supply to where it was used. The baths of the ancient Romans were elaborate, but there is no evidence extant to show that they had showers or any way to supply hot and cold water by turning a tap. All primit[illegible]hods of supplying water naturally [illegible]wasteful and therefore as the problems of supplying towns and cities with water gradually developed, it was realized that a much smaller initial supply would suffice if some means of regulating its use could be devised. Then if only enough was used to supply the actual needs of the people, the remainder could be conserved and held in reserve, instead of being allowed to go to waste. Problems thus introduced have served to build up large industries devoted to the production of devices for checking and controlling the flow of water. The largest of these are made of iron or steel, but practically all the small fittings for this purpose are made of red brass.

Among the firms engaged in this line of work is the Glauber Brass Mfg. Co., Cleveland, which produces a complete line of plumbers' brass castings. Over 10,000 separate patterns are in use in its foundry or stored in its pattern vaults. Nearly every conceivable size and type of brass water connection, from the brass screw in the service connection in the street main line, to the last valve leading to the waste pipe are made in its shops.

Operations Compactly Grouped

Every operation in connection with manufacturing the fittings is carried on in the one group of buildings. The metal is melted, molds made, castings poured, cleaned, machined, buffed, polished, nickel plated, assembled and shipped all in one plant. The company maintains a high standard for all its work and furnishes a five-year guarantee with all of its products against defect or deterioration. When it is realized that many of these castings are in constant use all day opening and closing and under constant water pressure, of from 50 to 70 pounds, it is apparent that the metal must be of a superior character and the parts fitted with the greatest degree of care and accuracy.

The metal is melted in a battery of seven oil-fired pit furnaces in a room 20 x 40 feet, partitioned off from the other departments. In addition to the furnaces, the room contains a chamber 6 x 8 x 12 feet lined with shelves on both sides, having a capacity of 100 crucibles. This chamber is kept heated constantly by a steam coil, to eliminate any possibility of the crucibles absorbing moisture from the atmosphere. Before the war some economical measures tending to prolong the life of crucibles were observed, but at the present time when the cost of crucibles has trebled and the cost of fuel quadrupled, such measures are a positive necessity. The roof of this room is 30 feet from the floor and is provided with a row of pivoted windows extending the full length of both sides to afford ventilation. A 40-inch suction fan situated in each of the gable ends of the roof serves also to draw the fumes and smoke from the furnace room. A light traveling crane spans the room from side to side and is provided with an air hoist having a capacity of 500 pounds. This is used for drawing the full pots out of the furnace. The air hose supplying the hoist is led from the floor up through a chamber alongside the door between the furnace room and the molding room. It passes over a sheave wheel located just under the crane rail. It pays out, or runs back over the sheave as the crane is pulled back or forth and in this way there is no slack hose hanging down to interfere with the work of the hoist or in any danger of being burned with the red hot pots. The bridge of the crane consists of a single section of an 8-inch I-beam. A similar beam is suspended from the roof of the molding shop at

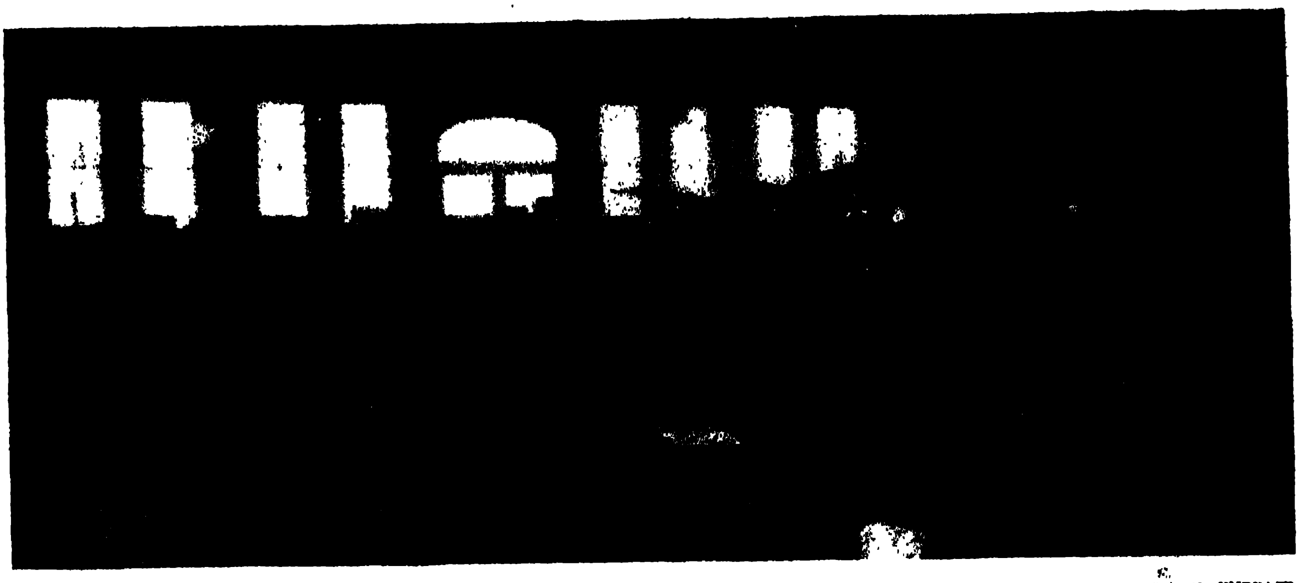


FIG. 1—ONE OF THE GANGWAYS SHOWING THE POURING STANDS—INSTEAD OF USING SLIP JACKETS, NARROW IRON BANDS ARE USED TO EMBRACE THE MOLDS AT THE JOINTS

the same height from the floor as the crane beam. This extension beam commences at the doorway connecting the furnace room and molding shop, and extends into the latter for a distance of 40 feet.

When a pot of molten brass is ready the furnace tender blows a whistle operated by compressed air and two foundry helpers repair to his assistance. The furnace man shuts off the oil, throws back the cover of the furnace and attaches the lifting tongs to the pot. One of the laborers pulls on an endless chain which operates the traveling mechanism of the hoist and brings the crane into position over the furnace where the hook engages the link of the tongs. The other laborer operates the valve which hoists the pot out of the furnace. The crane is then propelled back until the beam forming the bridge is in line with the beam extending into the molding shop. A safty catch worked by a chain from the floor is thrown into position locking the ends of the beam into a straight line and then the pot hanging from the trolley is pushed out through the doorway until it reaches the end of the beam. Here it is lowered off into a double shank resting on the floor. Any further additions to the metal are made at this stage. If the metal is too hot, one or more scrap gates are added to cool the crucible contents to the proper temperature.

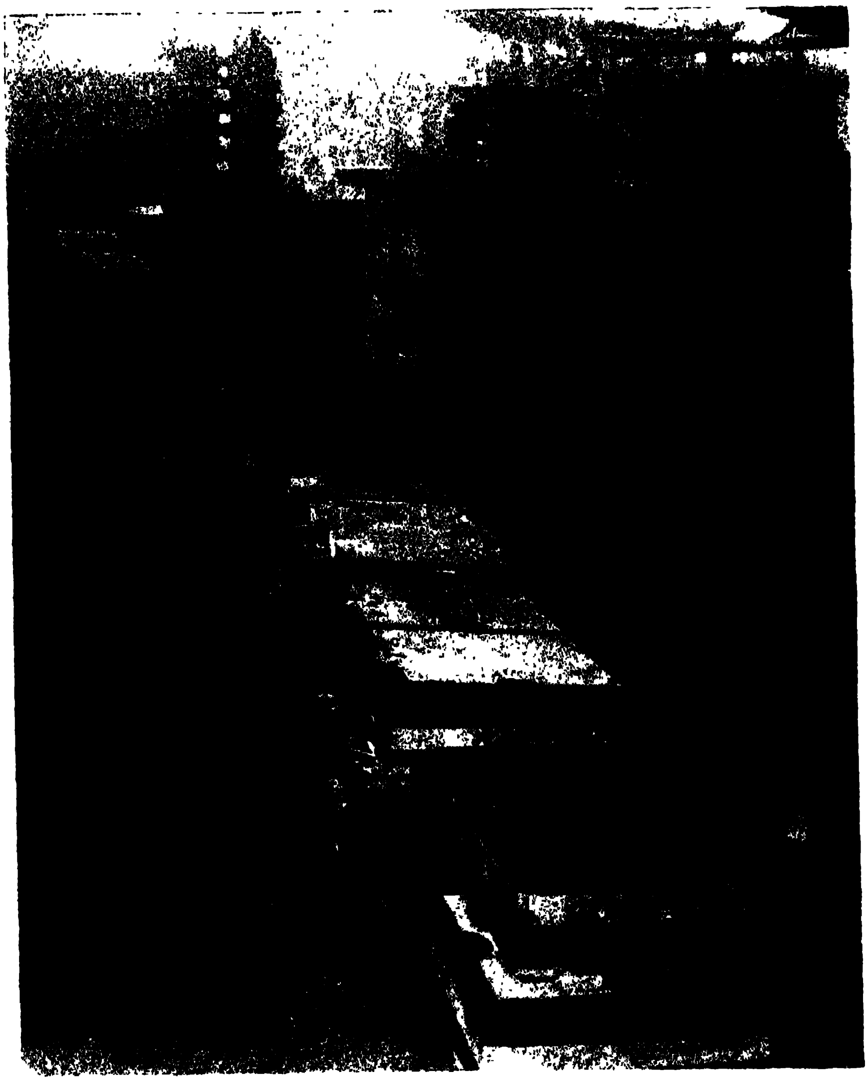


FIG. 2—METHOD OF STACKING THE MOLDS FOR POURING—ALL THE PATTERNS ARE ARRANGED IN GATES TO BE POURED FROM ONE END OR ONE SIDE

Several mixtures of metal are melted every day to meet the diversified character of the work on the floor. A mixture for the castings which have to stand the most severe service is made up of 80 and three fives; that is 80 per cent copper with 5 per cent each of lead, tin and zinc. The charge consists of approximately half and half virgin metal and scrap. Most of the scrap consists of sprues, and runners, defective castings, and turnings from the machine shop. In charging the pots which are all of a uniform size, No. 70, a large shovelful of turnings is put in first, then the new metal is added and then the scrap which is fed in constantly until the pots are full. A limited amount of foreign scrap is used but it is all

carefully graded and each kind kept in separate barrels provided for that purpose.

Each furnace is capable of melting about 6 pots a day. The first pot starting on a cold furnace requires about 1½ hours to melt, but after that the time averages about ¾ hour for each. The pots hold about 250 pounds, so the total daily capacity is between 5 and 6 tons. This would not mean so much if distributed among heavy castings but when it is used to pour castings some of which only weigh a few ounces the total quantity is enormous.

Judging the Metal Condition

The melter does not depend upon a pyrometer to gage the heat of the metal. By inserting a rod in the pot after his eye tells him it is about the proper temperature he can tell whether it is hot enough or not. When molten brass in the pot reaches the casting temperature, it imparts a vibration to the iron rod and the man holding the other end of the rod in his hand can judge the temperature by the character of the vibrations. The foreman examines each pot when it is lowered from the crane decides what additions if any are necessary to bring it to the proper pouring temperature and composition. He then sees that it is skimmed and tells the men where to carry it. Upon reaching the designated floor the molder working there takes the double end of the shank and pours his own work. Some of this work can be poured by ordinary labor but most of it requires a quick tip when starting and a quick cut at the end, a trick which only can be acquired through practice.

A plan of the foundry floor, which is 63 x 95 feet, is shown in Fig. 8. The floors are arranged in four groups. Two groups back to back along the center of the shop and the other two groups close to the side walls. Two wide concrete gangways parallel to the side walls are situated so that each gangway serves two groups of floors, one to either side as shown in Fig. 8.

A fine grade of sand is us[illegible] both molds and cores. Supplies [illegible]ceived from Ohio, Kentucky and I[illegible]ois sand beds and mixed in varying proportions for each class of work. The molds are all made on squeezer machines. The machines along both walls are plain hand squeezers while those on the floors back to back in the center of the shop are power squeezers made by the Tabor Mfg. Co., Philadelphia. The molds are carried from the machines and stacked two deep on frames made of two pieces of 2 x 4 lumber laid on each side of the gangway. The frames are mounted on 6-inch blocks, the object being to raise the runners a sufficient distance from the floor so that when the lip of the full crucible is brought close to the sprues the bottom will be clear of the floor. This further assists in pouring as the men do not have to bend so low. The more a man has to stoop, the greater difficulty he has in manipulating the shank.

Each man sets a row of about 10 molds on a frame in front of the floor,

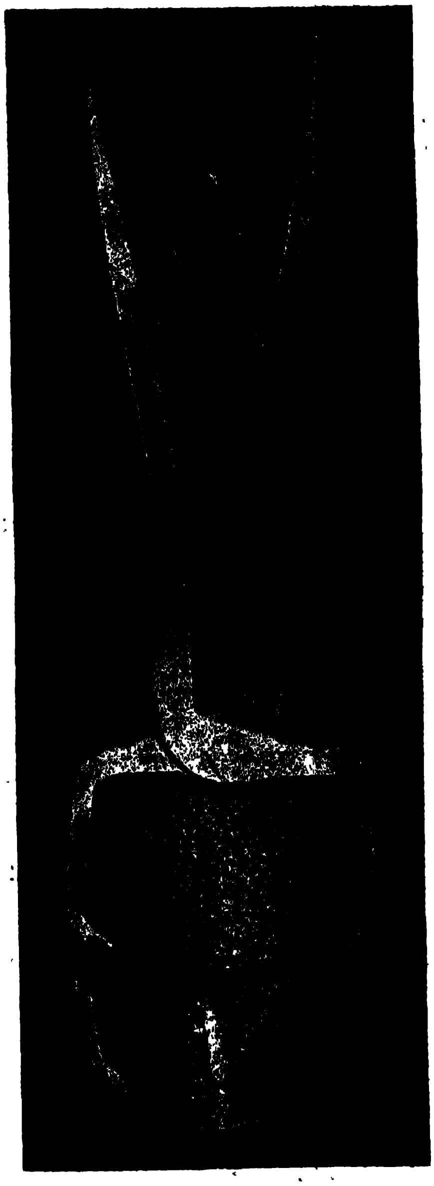


FIG. 3—DETAIL OF TONGS—NO LINK IS USED ON THE TOP—THE LIFTING HOOK EXERCISES SUFFICIENT TENSION TO HOLD THE POT FIRMLY

he then lays a thin flat plate on each one and a second row of molds is piled on top of the first. The top row is kept back about 3 inches to leave the runners in the lower row exposed. Flat plates are then set on the top row and a small weight placed on each mold. The bottom row of molds is poured first. This is done to guard against the possibility of metal splashing the runners while pouring the top row.

The molds are shaken out immediately after the last one has been poured. The castings picked up immediately by a pair of tongs and plunged into a tank of water. This treatment serves to clean them both inside and out. The steam generated blows the cores out and leaves the castings perfectly clean on the inside. Pouring goes on continuously all day.

The molders put up from 70 to 100 flasks a day but the floors are comparatively short because the molds are poured on each floor before more than 20 have accumulated. All the drippings, spills, overflows and skimmings are passed through a wet mill and the metal recovered. The return scrap from the finishing shop together with bearings and chips are passed through a Dings magnetic separator to remove any particles of iron or steel.

Cores are used so extensively in plumbers' fittings that there are practically as many coremakers as molders employed. Owing to the light section of metal the cores must be extremely accurate. This is accomplished by pasting them while green and drying them in dryers which hold them in shape and prevent distortion. The work in the core room is systematized and results in the production of from 300 to 400 cores by each coremaker per day. The coremakers sit or stand at two benches and do nothing but ram the cores and set them on plates. A helper keeps them supplied with sand, wire, paste and plates, and carries filled plates to the ovens. The latter, three in number, are the plain drawer shelf type fired by either oil or gas depending upon which is the more readily available. The gas and oil supply pipes terminate in the same burners and a switch can be made from one to the other at a moment's notice.

Preparing Wires in Quantity

One girl cuts all the wires required for the cores on a wire cutting and straightening machine and bends those which have to be bent on a cast iron plate 2 x 12 x 14 inches. This plate is perfectly flat on top and is provided with ¼-inch holes set close together over the entire surface. Plugs and stops are inserted in the necessary holes and the wires are bent around them to the required shape. By varying the position of the plugs, any desired shape of wire may be secured. Two half coreboxes are provided for each size of core. The sand is pressed into each half by hand, the necessary wires pressed into what will be the lower half, vent wires set, paste applied, and then one box is superimposed on the other, being located by suitable pins. The vent wires are withdrawn, the top box rapped and removed and replaced by a dryer frame.

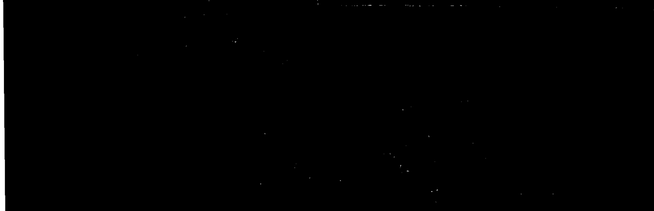


FIG. 4—ABOVE—THOUGH APPARENTLY VERY DELICATE, THE CORES ARE REALLY SUBSTANTIAL—THOSE ON THE LOWER RIGHT HAND PLATE ARE DRIED AS THEY STAND WITHOUT DRYERS FIG. 5—AT THE LEFT—THE PATTERNS ARE MOUNTED ON FOLLOW BOARDS MADE OF A COMBINATION OF LINSEED OIL AND SAND FIG. 6—BELOW—TYPICAL CORES FOR PLUMBERS' GOODS—THEY ARE MADE FROM AN OPEN FREE-VENTING FINE GRADE OF SAND—NOTE THE SYMMETRICAL SHAPE

The box is then turned over rapped and the other half of the core box removed, the core resting on the drier is placed on a plate and when the plate is filled it is taken to the oven. When the cores are taken from the ovens they are inspected by experienced men who reject any that may be defective. Minor defects are repaired and then the cores are placed on the racks ready for the molders.

Cleaning the Castings

The castings are cleaned by sandblasting, in a combined sandblast and tumbling barrel after which they are inspected, ground and polished. They are then taken to the machine shop where they are fitted and assembled after which they are tested individually for leaks or other imperfections. A complete nickel plating plant is maintained on the premises and any of the castings which are to be finished in that manner are passed through it and treated.

The company designs, makes and finishes its own patterns, coreboxes and dryers. All the parts are made of brass and highly finished. The core dryers and coreboxes are stored in bins and racks at one end of the shop while the patterns, which are all mounted on follow boards are kept, some in storage vaults and some on shelves on a balcony running the full length of the shop on one side. Part of this system of shelves is shown on the extreme right on Fig. 3. The patterns are all numbered and indexed to make them readily available when wanted.

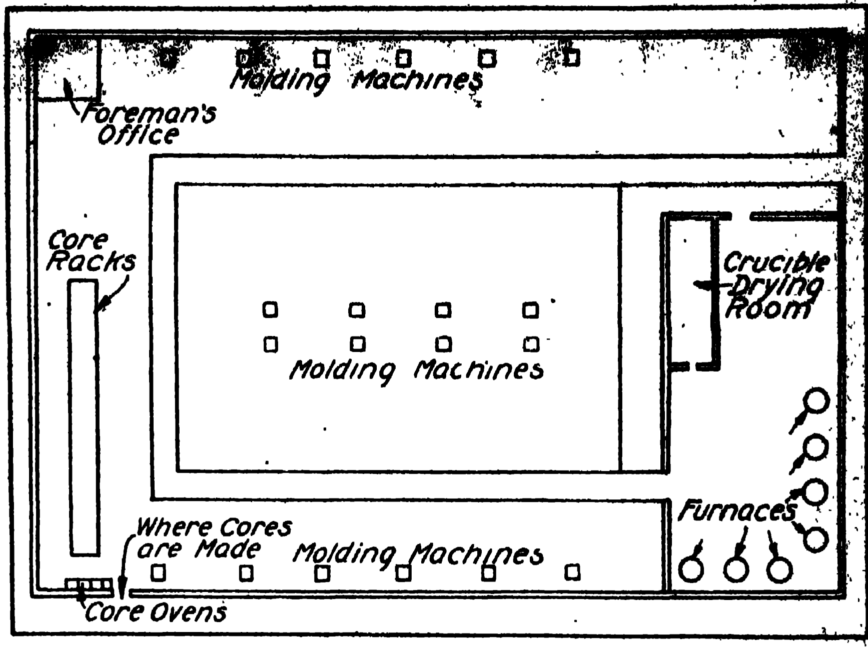


FIG. 8—LAYOUT SHOWING THE ARRANGEMENT OF GANGWAYS AND POURING FLOORS AND THE SEPARATE FURNACE ROOM

Oppose Metric System

In a new edition of the book entitled "The Metric Fallacy," the author, Frederick A. Halsey, commissioner of the American Institute of Weights and Measures, outlines the results of an investigation of the claims made for the metric system and especially of the claim that its adoption is necessary in the interest of the export trade. Chapter I is devoted to a brief history of the metric system in France. Metric standards were made compulsory by a drastic law in 1793 and remained in force 19 years or until 1812 when Napoleon, who had no faith in the system, had the law repealed. Under the relaxed laws, the people immediately reverted to the universal system in which 12 inches makes a foot, and continued the practice for 25 years or until 1837 when the metric enforcement laws were reimposed, continuing in effect until the present day.

In Chapter II, the replies to 500 questionnaires distributed in South and Central America and the West Indies indicate that the metric system is not used extensively in Latin America. The results of the questionnaires are tabulated in the back of the book. In but one country, Uruguay, can the metric system be said to be adopted for domestic trade and from this country answers were received to the effect that while the metric system was official, the English system was customary and no effort has been made to abolish it.

Another chapter is devoted to arguments against the claim that the metric system is necessary in the interest of foreign trade. A summary of the replies to questionnaires submitted to American exporters shows that of 1445 replies, 1189 did not use the metric system; 160 used is slightly; 29 used is considerably; 16 used it extensively; 5 used it exclusively and 46 did not reply. One manufacturer reports that 95 to 100 per cent of his tools shipped to South America are made to English unit specifications. Referring to engineering standards, it is stated that the compulsory adoption would mean revision in every industry.

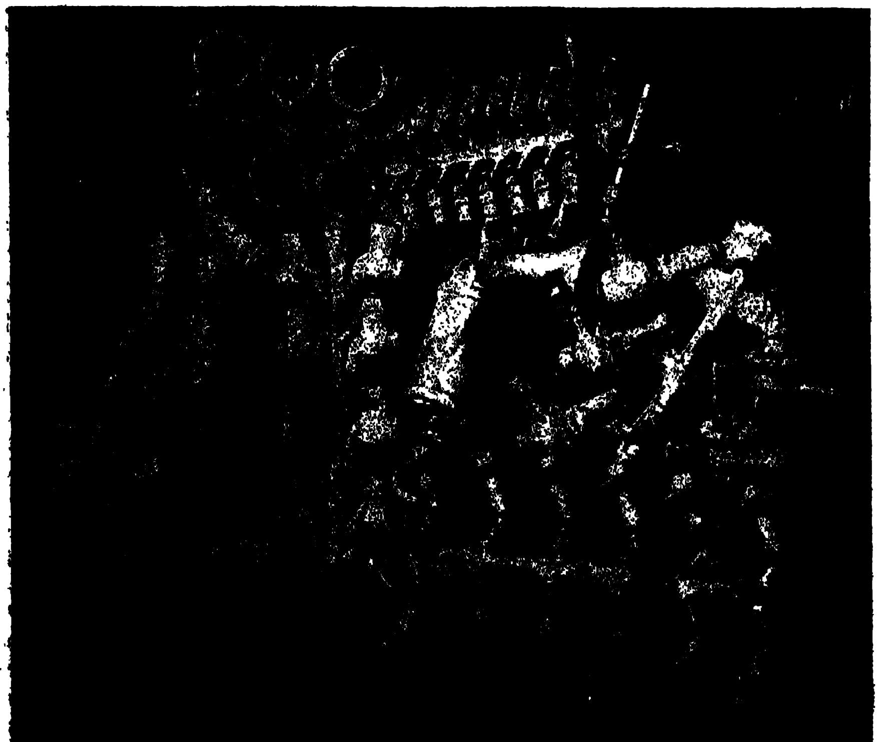


FIG. 9—A GROUP OF TYPICAL CASTINGS WHICH HAVE BEEN JUST SHAKEN OUT—NOTE THE CLEAN SURFACE, ABSENCE OF GATING AND ALMOST ENTIRE ABSENCE OF FINS

How and Why in Brass Founding

By Charles Vickers

Aluminum Specifications

We have been called upon to produce aluminum castings conforming to the following analysis and we have had considerable trouble in meeting the specifications in regard to elongation. The specifications for composition are: Aluminum, not under 94 per cent; copper, not over 6 per cent; manganese, not over 2 per cent; iron, not over 0.5 per cent. The physical properties demanded are, Tensile strength, minimum, 18,000 pounds per square inch. Elongation in 2 inches, minimum, 8 per cent. We shall appreciate any suggestions you may have to offer.

In a paper on Aluminum Castings and Forgings, presented before the American Institute of Metals, and embodied in the Transactions of the Institute for 1916, P. E. McKinney gives tests of sand cast bars of an aluminum alloy which meets the requirements mentioned. The alloy consisted of aluminum, 96 per cent; copper, 2 per cent, and manganese, 1.50 per cent. A series of 11 tensile tests were made the average tensile strength being over 20,500 pounds per square inch, and the average elongation being over 12 per cent. We would suggest, therefore, the above alloy be used as in none of the 11 tests did the elongation go below 8 per cent, or the tensile below 18,000 pounds per square inch.

Soldering Aluminum

We would like to learn if the following solders are suitable for soldering aluminum: Aluminum, 20 parts; zinc, 80 parts. The aluminum is melted first then the zinc is added gradually, and when all is down a flux of fat is stirred in with an iron rod. The alloy is then ingoted. It is used in connection with a flux consisting of copiaba balsam, 3 parts; venetian turpentine 1 part; lemon juice, a few drops. The soldering iron is first dipped into the flux, then is applied to the solder in the usual manner.

An alloy of 80 parts zinc, and 20 parts aluminum has too high a melting point to be applied with a soldering iron. The flux has no value because it has no action on the film of oxide covering the aluminum which prevents the solder sticking. This film must be removed by scraping while the solder is flowing. The surfaces are first thoroughly cleaned, then the aluminum must be heated until the solder melts. It is made to *tin* the aluminum by thoroughly scrubbing the surface with the solder, or by melting the solder then scrubbing the aluminum under the solder. When the aluminum is tinned, ordinary half and half solder will adhere. Fluxes should not be used. They do not cause the solder to adhere but dirty the aluminum.

The following alloy is commonly used for solding aluminum. Tin, 86 per cent; zinc, 9 per cent; aluminum 5 per cent. Melt the aluminum in a crucible, add the zinc in the form of sheet, a little at a time. When all is melted stir well, and add the tin with more stirring. Pour into strips. To apply, heat the aluminum surface to the melting point of the solder, and scrub the latter on the aluminum, thus tinning the aluminum. The tinned surfaces then are soldered in the ordinary manner.

Nonferrous Metal Fluxes

We would like to learn what fluxes are commonly used in melting brass and bronze, also for aluminum alloys.

The important point in melting any alloy of copper is to protect the metal from the gases generated by the burning fuel, because it absorbs some of these gases, and combines with others, producing a metal that may be filled with holes like bread, or it may be mixed with dross formed by a combination of the gas and the copper and other metals in the alloy.

Anything that will cover the metal after it has melted, and will produce a gas that protects the metal before it is melted, is of great assistance to getting sound castings. For these purposes charcoal is universally used; hard wood blocks also are excellent. In addition to this protection it is advisable to use some flux such as a mixture of soda ash, sand and lime which melts and forms a glass that covers the surface of the metal. For ordinary red brass, bottle glass is quite satisfactory.

For aluminum flux use a piece of fused zinc chloride the size of a hazel nut to a crucible full of aluminum. Add the chloride after the aluminum is melted and before taking it from the furnace, by simply dropping it onto the metal and stirring.

Composition of Electric Contact Castings

We would like to obtain a formula for trolley wheels and other electric contact castings, which are high in conductivity and will wear well. The metal should be red in color. Any information you may be able to give will be thankfully received.

The conductivity of the metal in a trolley wheel is not so important as its nonarcing qualities. Some alloys, notably those containing much lead and also the copper zinc alloys, form arcs as the wheel rolls along the wire. These arcs produce on the tread of the wheel little hard pimples which abrade the wire. The following alloy makes a good trolly wheel: Copper, 92.50 per cent; phosphor copper, 0.5 per cent; tin, 7 per cent. A copper colored wheel can be produced by decreasing the tin and increasing the phosphor-copper, but its conductivity will be no greater than that of the alloy given first. More difficulty is experienced in casting it and getting clean castings, on account of the higher percentage of phosphorus. If any difficulty is experienced with 0.5 per cent of phosphor copper from the metal cutting into the sand, the amount used may be decreased, as 0.10 per cent phosphor copper is sufficient for deoxidizing purposes. For trolley ears and overhead fittings use the following alloy Copper, 87 per cent; tin, 4 per cent; zinc, 6 per cent, and lead, 3 per cent. For electric contact castings use copper only where conductivity is important.

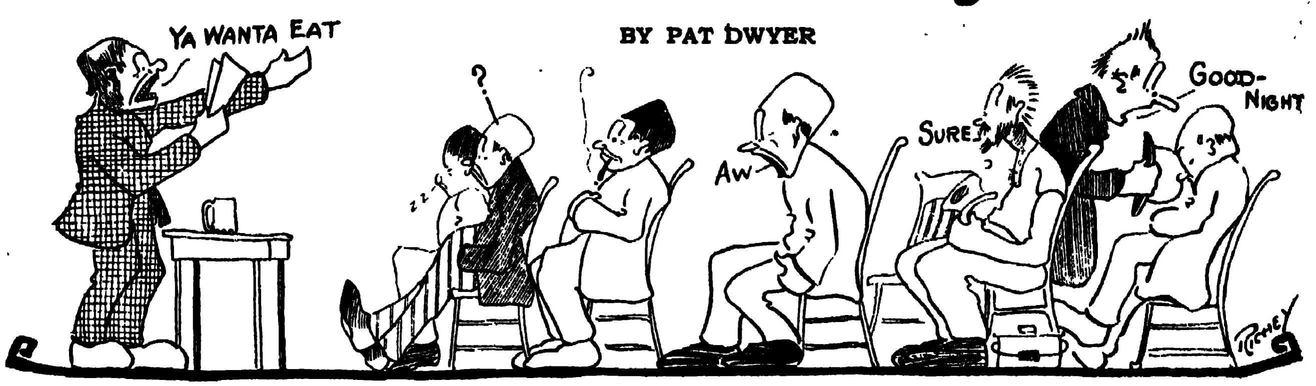
Bronze Bushing Alloys

We would like to obtain the formula for an alloy suitable for bronze bushings, which can be machined easily, will give good service and also be cheap.

The following alloy will fill the requirements satisfactorily: Copper, 78 per cent; tin, 7 per cent; lead, 15 per cent. If a deoxidizer is considered necessary add 0.25 per cent of a phosphor copper containing 15 per cent of phosphorous. First melt the copper under charcoal, add the phosphor copper and stir thoroughly, then add the tin and lastly the lead. This alloy will run clean castings and will prove an excellent bearing alloy.

Bill Makes a Steel Pinion For Large Mill Drive

BY PAT DWYER

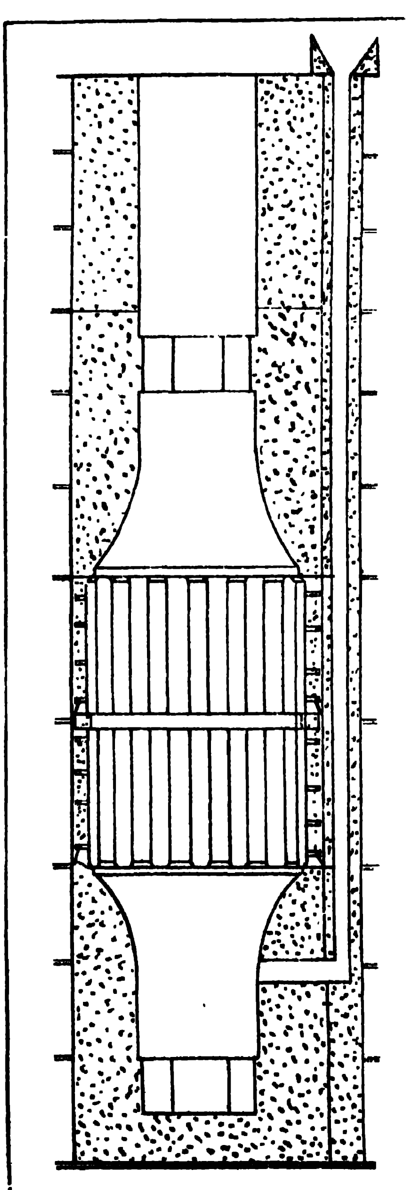


DURING a meeting which Bill and I attended one night recently a well-meaning citizen read a paper entitled, "The Importance of Selecting the Right Kind of Breakfast Food." Bill did not wait to hear it all; he told me that he would wait for me outside if I intended to be a goat and stay until the meeting was over. I will be honest enough to confess that it was politeness and not interest that prevented me from following his example, but I stayed. After the meeting was over I found him waiting and we walked together to the car line.

"That kind of drivel makes me tired," said he. "It is my opinion that it does not make a bit of difference what a man eats for breakfast or any other meal as long as he gets enough of it. At the present time, the burning question is not 'What shall we eat,' but 'What can we get to eat?' It is the same with any other question you wish to consider For instance, there is a general impression among foundrymen that there is only one kind of sand in the world fit to make castings, and that is the kind they have always used. They pooh-pooh and laugh you to scorn, etc., if you suggest using any other kind, even in an emergency. Now I'll tell you about a double staggered tooth driving pinion for a blooming mill that I made one time under peculiar circumstances. This little episode occurred while I was connected (connected is good) with a comparatively new iron and steel plant.

"After the blooming mill had been running some time one of the main driving pinions broke and it was found that there was only one spare on the plant. An order was placed with the nearest steel foundry which in this case was 1000 miles away for a new casting and to guard against a shut-down the master mechanic decided that he would have a pair cast in the open-hearth department of the plant.

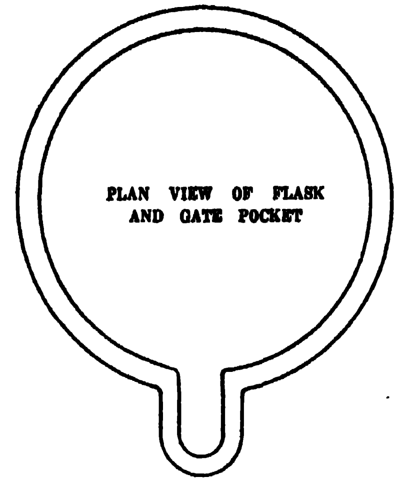
"We had no silica sand at the time, but we had in the iron foundry a large supply of different kinds of ordinary molding sand for iron and brass castings. Included in this lot was a supply of coarse, open sand which we used on dry sand and loam work Considerable doubt was expressed about the ability of this sand to stand up to steel. When the master mechanic asked my opinion, I told him that I saw no reason why it should not give satisfactory results. I don't mind telling you that I was not as confident as I led him to believe, but I was not going to miss such a beautiful chance to find out definitely. I'll say this for him, he was a brave lad for he took my word for it and convinced the general manager, the purchasing agent and the blooming mill superintendent that it could be done.



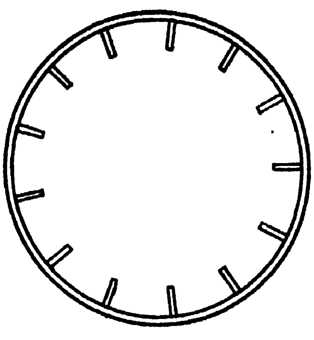
SECTION OF COMPLETED MOLD

"This casting was no toy. It was 3 feet in diameter across the teeth; it was nearly 15 feet long, including the sink head; and it required about 15 tons of steel to pour it. Having settled all the preliminaries, actual work was commenced by issuing shop orders for a pattern and a set of flasks to mold it in. The flasks all were cast and ready several days before the pinion pattern was given the last coat of yellow shellac. The core print around the middle was painted a brilliant vermillion and the *tout ensemble* certainly was handsome.

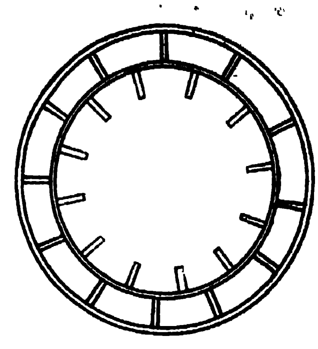
"The flask was made in 11 sections, nine of them were alike, being 14 inches while the other two were 26 inches deep. The two deep sections were to carry the teeth, three shallow sections were required to house each neck and wabbler and the remaining three sections enclosed the sink head. These flasks were made after the style of those used for making rolls. They were flanged top and bottom and were provided with an extension to accommodate the upright runner. One pattern 14 inches deep was used to make all the flask sections. It was the correct depth for them all except the two deep sections which were to contain the mold for the teeth To make the deep sections the pattern was rammed in the usual way and then drawn up and rammed again, until the required depth was reached. The pattern carried a top flange but the lower flange on each section was molded on by the use of flange cores. This arrangement did away with



PLAN VIEW OF FLASK AND GATE POCKET



ARBOR FOR THE TEETH



ARBOR FOR THE TOP NECK

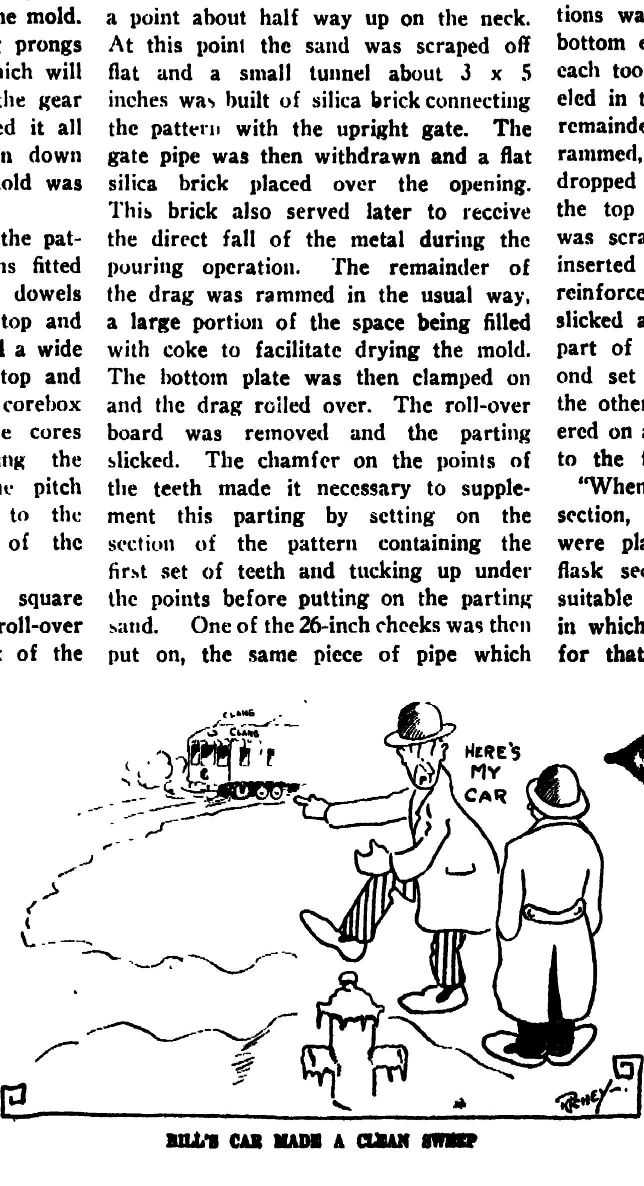
the necessity for either lifting out the core or cheeking off the outside. The mold for the bottom plate for the flask was made by setting the pattern flange down on a prepared bed of sand and banking the sand around the flange to the depth of about an inch.

"We also made nine arbors, four for each set of teeth and one to carry the sand in the top neck section of the mold. Three of these arbors had long prongs cast on them, the purpose of which will be touched upon again. When the gear and rigging was ready we loaded it all on a flat car and had it taken down to the open hearth where the mold was made.

"For convenience in molding, the pattern was made in seven sections fitted together in the usual way with dowels and dowel pins; two wabblers, top and bottom neck, two teeth sections and a wide core print which separated the top and bottom sets of teeth. A segment corebox was provided for making these cores which were used for reducing the shrouding in the center to the pitch line and have it correspond to the shrouding on the extremities of the teeth.

"We put down an ordinary square wooden bottom board for a roll-over board, centered the bottom neck of the pattern on it, and then lowered on one of the 14-inch flask sections. A piece of 3-inch pipe about 4 feet long was placed in a vertical position in the pocket of the flask provided for that purpose. This served as a gate pin. Facing sand, which consisted simply of new sand passed through a No. 4 riddle, was used to cover the pattern to the depth of about 2 inches and then enough old sand was shoveled in to form a ramming. The piece of pipe also was surrounded by new sand. A piece of rod was bent and laid horizontally between the pipe and the flange of the pattern on the first ramming but no further rods were used. New sand was used to face the pattern and gatepipe all the way up. The other two flask rings were put on and successive courses of sand were rammed until it had reached a point about half way up on the neck. At this point the sand was scraped off flat and a small tunnel about 3 x 5 inches was built of silica brick connecting the pattern with the upright gate. The gate pipe was then withdrawn and a flat silica brick placed over the opening. This brick also served later to receive the direct fall of the metal during the pouring operation. The remainder of the drag was rammed in the usual way, a large portion of the space being filled with coke to facilitate drying the mold. The bottom plate was then clamped on and the drag rolled over. The roll-over board was removed and the parting slicked. The chamfer on the points of the teeth made it necessary to supplement this parting by setting on the section of the pattern containing the first set of teeth and tucking up under the points before putting on the parting sand. One of the 26-inch cheeks was then put on, the same piece of pipe which was used for a gate in the drag being set in and located by dropping one end into the opening in the joint. About ¼-inch of facing sand was sprinkled on the joint and one of the arbors which had three prongs on the lower side was clay washed and lowered in until the prongs rested on the sand strip with which each of the flask sections was provided on the inside at the bottom edge. Four gaggers were set in each tooth space and enough sand shoveled in to make the first ramming. The remainder of the ring was filled and rammed, three additional arbors being dropped in at equal distances. When the top was reached the surplus sand was scraped off and four 6-inch spikes inserted in the top of each tooth for reinforcement The joint was then slicked and the core print set on. The part of the pattern containing the second set of teeth was then located and the other deep section of flask was lowered on and rammed in a manner similar to the first.

"When the parting was made on this section, the second neck and wabbler were placed and three of the 14-inch flask sections hoisted into position. A suitable arbor or grating was lowered in which also rested on prongs provided for that purpose. This section of the mold was rammed up to the top of the wabbler. An 18-inch diameter ring pattern was set on top of the wabbler and the sand rammed up flush with the top edge of the flask. This ring formed the lower end of the sink head, or perhaps it would be clearer to say it formed the connecting link between the wabbler and the future green sink head. The remaining three sections of the flask were not rammed at this time; they were rammed up later in green sand when assembling the mold for casting.



BILL'S CAR MADE A CLEAN SWEEP

The top of the last section was scraped off flush, the ring pattern withdrawn, a round plate clamped on and then the work of taking the mold apart was begun. The section containing the top neck and wabbler was taken off first, turned and lowered to the floor. The pattern was drawn out, the mold finished and given a coat of silica wash. It then was rolled back again and set up on some empty flasks to enable us to build a wood fire under it.

"The first section of the teeth pattern was drawn next. We had to use one of the 75-ton open-hearth cranes to draw the patterns. The operator was an artist He drew those patterns as nicely and as steadily as any foundry crane man could do it. The upper cheek section was then lifted off and lowered upon suitable stands where it was finished and whitewashed. The lower cheek was treated in the same manner. The lower neck pattern was drawn last and the mold finished and whitewashed. We built wood fires under each section with the exception of the drag, which we dried with a gas flame.

"The open-hearth furnaces in this plant were the tilting type, set level with the floor, and having a pit in front in which the ladles were lowered while tapping heats. The complete pinion mold was 16 feet high from the bottom plate to the top of the runner, so we decided to assemble it in the pit of one of the furnaces which was temporarily off for repairs.

"Accordingly the drag was picked up first, carried to the pit and lowered down until the bottom plate rested on the brick floor. The two cheek sections containing the teeth were put together where they were and the ring cores which made the gap between the two sets of teeth were inserted. These cores had been dried in an oven improvised for the occasion out of a few iron plates. The two sections were clamped together, picked up by the crane and lowered on the drag in the pit. The cope section was then put on, a ring pattern placed in the [illegible]r, the remaining three sections of flas[illegible]wered on and rammed full of green [illegible]

"Instead of using a pipe for [illegible] runner in the green sand section, we used sleeve bricks built on top of each other. The mold was then clamped at the joints, a runner cup set on and we were ready to pour. We had no choice in the analysis of the metal We had to take either one of the different varieties of steel the open hearth was making at that time. The nearest to what we wanted was an axle mixture of about 0.45 per cent carbon. We poured it from that heat and I heard afterward that it was the best wearing pinion that was ever put into the blooming mill."

"How did the sand act?" I said. "Did it skin off all right?"

"Sure," said he. "The outside peeled off as clean as any casting you ever saw; we had to do some chipping in the teeth but I believe that would have been obviated if we had facilities for drying the mold properly in an oven."

Just then Bill's car came into view and as he stepped off the curb he handed me this little gem of wisdom: "It is all right for a young fellow to fuss over his breakfast food, but a married man, if he has any sense, will take what he gets and be thankful if he does not have to get up and prepare his breakfast as well as eat it."

Method of Making the Cupola Bottom

By H. E. Diller

Question—How and through what opening is the bottom made in a drop-bottom cupola? In England our cupolas have solid bottoms and openings are provided in the back, opposite the tap hole, for pulling out the unburned coke after the heat. With this method new bottom need be made only occasionally.

Answer.—In drop-bottom cupolas the two semicircular doors which form the bottom are swung down after every heat. This allows all the unburned coke, the slag and any metal which has not been melted to drop through to the floor. The refuse, in many foundries, is put through a water mill to reclaim all the iron in it. Not only does the refuse from the cupola fall out when the bottom is dropped, but the sand which formed the bottom comes with it. This necessitates the making of a new bottom after each heat. To do this the bottom doors are closed after the side walls of the cupola have been patched and the breast of the cupola has been made.

This patching is done with a mixture consisting of half molding sand and half fire clay and a hole for tapping is formed in the breast. Then sand is thrown in through the charging doors. A ladder is put through the charging doors and a workman goes down to tamp in the sand bottom. Usually the first layer about 2 inches deep is made of gangway or refuse sand. This is generally covered with a layer of molding sand of the same thickness. The sand should be damp but care must be taken that it is not too wet. Scrap wood is used to start the fire. It is laid on the bottom and stood up along the sides. At two or more tuyeres finer wood is placed with which to start the fire. After a portion of the wood has been placed the workman comes out of the cupola and withdraws the ladder. The remainder of the wood is then dumped on top of that already placed. A portion of the coke is also charged and then the fire is lighted. When a good fire is burning and a blue flame comes from all over the top the remainder of the coke for the bed is added. After a blue flame again appears charging of the metal begins.

British Foundrymen See German Practice

Recently a deputation from the British Brassfounders' association visited German works to study foundry conditions in the Rhineland. According to the *Iron and Coal Trades Review* this deputation has reported that the main advantage the German founder has is in the smaller variety of articles produced by each manufacturer combined with careful attention to details by all the employes.

An unusual practice was noticed which was common to all the German brass foundries visited. This consists of putting molds into an oven as soon as they are made and leaving them there until the next morning when they are taken out and poured at some time during the day.

Molds are placed on top of each other when cored, in piles 3 or 4 feet high. Each pile is clamped together and then set on end for pouring in the usual manner. It was noticed in several instances that loose locating pegs were inserted in the sand of the mold to assist in accurately matching the cope and drag. Both pit and tilting furnaces were employed for melting.

Organizes New Foundry

The Greensburg Foundry Co., Greensburg, Ind., has been organized with R. G. Dock, president, and J. E. Evans, secretary and treasurer. Mr. Dock will continue the operation of his machine shop as a separate organization, while Mr. Evans, who has been with the Dayton Malleable Iron Works, Dayton, O., will assume active management of the new foundry which will specialize in malleable automobile and jobbing castings.

The Keller Pneumatic Tool Co., Chicago, has been awarded the contract to supply the navy yards with all their requirements in pneumatic riveters, chippers, scaling hammers and holders-on for the present fiscal year. The first order was for 3946 tools divided as follows: Riveters, 881; chippers, 1428; scalers, 896, and holders-on, 291.

Learn Semisteel Facts From Shell

The Sum of the Percentages of Total Carbon and Silicon in the Metal is an Index of Its Strength—First Portion of the Heat is Found to be Inferior in Quality

BY FRANK E. HALL

WAR showed the necessity for a metal stronger than cast iron to supplement the supply of steel. So patriotic metallurgists were spurred to new efforts to improve the status of that half-breed of the metal world that had been, more or less erroneously, christened semisteel. As a result, it was developed that for certain purposes semisteel was superior to steel in the manufacture of shell.

Steel, because of its greater strength and toughness, is able to carry a heavier charge of explosive, consequently, a steel shell can be expected to cause greater destruction when used against fortifications or other inanimate objects. On the other hand semisteel, because of its comparative brittleness and its resulting greater fragmentation, is capable of inflicting more serious loss of life when used against opposing forces of men. Therefore, each has its proper place in the economy of war.

For the present purpose, steel may be defined as a comparatively pure iron whose physical nature is modified by small amounts of carbon, silicon, sulphur, phosphorus, manganese, and possibly other rare elements; while cast iron generally is limited to approximately 93 per cent of iron, the remainder consisting of larger percentages of carbon, silicon, sulphur, phosphorus and manganese. Semisteel may be defined as cast iron in which the carbon and silicon have been reduced to as low a point as is consistent with maintaining the nature of gray iron, and in which the remaining elements are manipulated so as to give the greatest strength.

The fact that the addition of steel scrap, in varying percentages, is the means used to reduce the carbon, together with the fact that a considerable increase in strength results, is probably the explanation of the origin of the name semisteel. That ordinary grades of steel show from three to four times the tensile strength of cast iron is due to the fact that the crystals, or grains, of cast iron are interspersed with flakes of graphitic carbon, which break up the continuity of the mass and form surfaces of cleavage, which weaken the whole structure. Ordinarily about 3 per cent of graphitic carbon is present in cast iron, but as the specific gravity of graphite is 2.15 and of cast iron 7.20, the space occupied by the graphite is upward of 10 per cent; so when it is considered that the graphite is present in flakes, or plates, and not in grains, the reduction in strength is easily understood. The production of semisteel involves a reduction of graphitic carbon to approximately 2.40 per cent. In addition, the reduced silicon content and other factors entering into the situation tend to change the flakes of graphite into finer particles of more compact shape, rendering the structure more homogeneous and, consequently, stronger. It is easily possible to double the strength of ordinary cast iron by the addition of steel scrap and the proper manipulation of the controlling constituents.

Chemistry of Semisteel

A number of features are of prime importance in securing consistent results when making semisteel. Foremost among them are the careful control of the chemical composition of the metal and extreme care in maintaining uniformly the proper melting conditions as well as the conditions surrounding the pouring and subsequent heat treatment of the castings. As increased strength is the main object sought, the carbon and silicon must be reduced. The extent to which this reduction may be carried is limited by the size of the casting, the material of which the mold consists, the subsequent heat treatment, and, to some extent, by the percentage of sulphur and manganese contained. The lower the total carbon, the greater is the tendency of the carbon to remain in the combined state for any given silicon content; so in order to safeguard the castings from "chilling white" it is necessary to increase silicon as the total carbon decreases. A generally accepted rule is that for a shell of 155 millimeter in diameter or larger, the total carbon plus the silicon should be maintained at approximately 4.40 per cent, although it will be seen from the analysis in the accompanying table that excellent results have been secured with a total considerably below this figure.

The total carbon is more difficult to control than is the silicon, for in the cupola, carbon is absorbed from the fuel in varying amounts, depending on the conditions surrounding the melting. As a result the total carbon is always greater than the calculated amount, and it is not always possible to forecast accurately the reduction that will result from the use of a given amount of steel scrap. The silicon, on the other hand, loses more through oxidation than is the case in melting ordinary gray iron. The variations of these two elements are such that accurate and rapid laboratory methods are imperative in order that as close control of the composition as possible may be maintained.

In addition to the requirement for high tensile strength, the manufacture of shells demands a certain degree of toughness, or freedom from excessive brittleness, to insure against breaking in the gun. This feature involves carrying a low phosphorus content, in addition to the precaution against allowing the total of the carbon and silicon to become so low that brittleness will result. In order to meet the present requirements in this respect, a phosphorus content not to exceed 0.120 per cent is desirable. The effect of manganese is practically the same as in the case of ordinary gray iron and, as in the case of other low-silicon castings, is preferably carried from 0.75 to 1.00 per cent.

Sulphur, never a desirable constituent, tends to increase abnormally in semisteel, due to a number of conditions. Chief among these is the ready absorption of this element by the steel scrap, which necessarily consists of moderate-sized pieces. As these become red hot before the larger pieces of pig iron and require

 From a paper to be presented at the meeting of the institute, New York, Feb. 16 to 19. The author, Frank E. Hall, is director of laboratories, American Radiator Co., Buffalo

greater heat to melt, they remain longer in contact with the sulphurous gases from the fuel. As the latter is required in greater amount in order to insure the proper melting of the steel scrap, it naturally furnishes more sulphur. The rigid requirements of the manufacture of semisteel shells involve a large percentage of remelt than in ordinary practice, which also tends to a higher sulphur content, so that special care in the selection of materials and attention to the details of the process are needed to insure as low a percentage of sulphur as possible.

In the accompanying table are given a number of selected analyses with the results of the accompanying tensile and impact tests and, in some cases, the brinell hardness. These analyses have been selected to cover as wide a variation as possible within working limits and, in a few cases, special portions of heats have been shown in which the impact test fell below requirements.

Semisteel Requirements

It is perhaps fair to remark that there was some uncertainty as to just what was necessary in regard to the strength of shells to meet the requirements so recourse was had to the tests developed in France for like purposes, with such modifications as it was thought would simplify their application to our system of weights and measures. It is probable that further study in actual service will be necessary before a system of tests can be devised that will, at the same time, safeguard the quality of the product and enable the manufacturer to produce satisfactory shells without suffering an abnormal penalty in rejected material. The tests, as finally outlined, were as follows:

Physical Tests—Test bars shall be taken from the pouring ladle at each cast of approximately 2000 pounds and each bar shall be cast in a vertical mold of the same material as that in which the shells are cast. The cooling of the test bars shall be performed under the same conditions as the cooling of the shells.

Tensile-strength Test—The test bar shall be cast 1.25 inches in diameter, with a length of 8 inches and a riser of 4 inches. At each end of the bar, for a distance not exceeding 2 inches, the bar may be cast with a maximum diameter of 1.5 inches, in which case the riser shall be of the same diameter. After removal of the riser, the test specimen shall be machined at its central portion to a diameter of 1.128 inches for a minimum length of 4 inches. The tensile strength of the specimen must be at least 32,000 pounds.

Impact Test—The test specimen 1.50 inches square, and not exceeding 1.52 inches on any side, shall be cast with a length of 8 inches and a 4-inch riser of the same area, between which and the bar there may be a neck of decreased area to permit the riser to be readily knocked off. After removal of the riser, the bar shall be placed on two angular supports having edges with a radius of 0.08 inch and in turn supported on a one-piece anvil weighing at least 1750 pounds and resting on a concrete or other solid foundation. A weight of 25 pounds, having its bottom curved on a 2-inch radius, shall be caused to fall exactly on the middle of the test bar. The test shall begin with the weight at a height of 12 inches and shall be repeated, always striking the same face of the test bar, with the height of the weight increased by ½ inch intervals until the bar breaks. The height of fall for causing rupture shall be not less than 18 inches, this height being measured from the upper surface of the bar to the lowest part of the testing weight.

Hardness Test—Hardness must not be less than represented by an indentation of 4.6 millimeters diameter on Brinell machines at 3000 kilograms.

A study of the accompanying table, and other data accumulated during a considerable period of manufacture, indicates that the impact test is more or less erratic, as at present applied.

The statement has at times appeared that too high a tensile strength was not advisable, for the reason that, above reasonable limits, the impact test was likely to show a brittle iron and that the toughest iron was apt to be that which ran rather close to the lower limit in tensile strength. While this statement has been borne out in a very few cases in the operations upon which this paper is based, by far the greater number of cases show an increasing toughness with increasing tensile strength, as in the case of numbers 11 and 13 of the table. Number 10 is one of the few exceptions mentioned.

Tensile Strength is Limited

There is a limit to which the tensile strength can be carried, however, for when the total carbon and silicon content falls much below 4.40 per cent, the semisteel becomes difficult to melt and is sluggish in the molds, so that slag and gases do not readily free themselves from the metal and defective castings result. For example, No. 13 shows a total carbon and silicon content of 3.87 per cent. While the tensile strength was above normal and the impact test showed good toughness, some of the test bars from this heat showed flaws from sluggish metal.

The total of carbon and silicon content below which it is unsafe to go is probably in the neighborhood of 4 per cent. It would not be wise to continue at this point for many heats in succession as, in addition to the liability to sluggish metal, there is danger of its chilling white unless carefully cooled, the more so as the remelt is returned day after day. The best results appear to lie between 4 and 4.40 per cent, with the total carbon remaining as near 3 per cent as possible and the combined carbon at or near 0.60 per cent. Analyses 2 and 2-A represent respectively the third and the thirtieth ladle from the same heat and are reproduced to show the tendency to weakness of the first metal from the cupola.

Second only to the necessity for careful chemical control is the need of a refined cupola practice, as it is easy to spoil an otherwise perfect mixture for semisteel, by lack of attention to details in melting. It is of the utmost importance that the coke bed be thoroughly ignited and leveled and that the charges be placed with the utmost care

Analyses and Tests of Semisteel Samples

	Mixture			Chemical analyses								Physical tests			
No.	Pig iron Per cent	Steel Per cent	Remelt Per cent	Silicon Per cent	Sulphur Per cent	Phosphorus Per cent	Manganese Per cent	Graphitic carbon Per cent	Combined carbon Per cent	Total carbon Per cent	Silicon and total carbon	Tensile strength lb. per sq. in.	Impact test inches	Brinell hardness at 3000 kg.	Remarks
1	39.4	25 2	35.4	1 04	0.118	0.100	0.76	2 57	0.65	3.22	4.26	35,570	19½	4.25 m/m 4.50	
2	40.5	24.8	34.7	1.15	.....	.....	0.72	....	....	3.22	4.37	33,380	17½		Third ladle
2A	40.5	24.8	34.7	1.01	0.101	0.080	0.80	2.60	0.62	3.22	4.23	38,510	20½		Thirtieth ladle
3	41.4	24.4	34.2	1.37	0.107	0.094	0.80	2.54	0.60	3.14	4 51	34,080	19		
4	40.5	24.8	34.7	1.26	0.104	0.092	0.81	2.50	0.63	3.13	4 39	37,630	18		
5	34.1	30.4	35.5	1.09	0.121	0.111	0.55	2.35	0.65	3.00	4.09	34,960	19		
6	34.0	33.0	33.0	1.10	0.109	0.108	0.64	2.13	0.71	2.84	3.94	46,960	18		
7	38.9	23.5	37.6	1.40	0.095	0.102	0.70	2.42	0.64	3.06	4.46	41,310	19	4.3	
8	39.2	23.4	37.4	1.01	0.100	0.113	0.66	2.32	0.67	2.99	4 00	41,490	18	4.1 m/m 4.3	
9	39.5	23.3	37.2	1.48	0.110	0.112	0.58	2.49	0.47	2.96	4.39	44,910	20	4.0 m/m 4.1	
10	34.4	32.8	32.8	1.28	0.123	0.104	0.60	2.36	0.66	3.02	4.30	49,030	17		
11	33.7	33.1	33.2	1.07	0.111	0.120	0.61	2.35	0.60	3.01	4.08	47,220	20		
12	38.9	23.5	37.6	1.38	0.102	0.102	0 72	2.45	0.61	3.06	4.44	32,810	15	4.1 m/m 4.2	
13	33.6	33.2	33.2	1.06	0.118	0.106	0.60	2.09	0.72	2.81	3.87	43,440	20.5		
14	36.7	21.9	41.4	1.61	0.119	0.120	1.10	2.51	0.60	3.11	4.72	37,840	16.5	4.0 m/m 4.1	

to maintain compactness and uniformity and a proper division between the coke and metal layers; the cupola should be kept filled to the charging door.

As the material composing the charges for semisteel has a greater tendency to oxidation, it is important that careful attention be paid to the fluxing of the cupola. Limestone used alone is satisfactory, provided the heats are not more than 5 hours in duration. It should be from 7 to 10 per cent of the weight of the metal charge. A good depth of slag should be carried above the metal to admit of the thorough cleaning of the molten metal as it drips through this blanket of slag. For heats longer than five hours, it is advisable to substitute fluor spar for a portion of the limestone. From 15 to 20 per cent of the weight of the limestone may be replaced satisfactorily by fluor spar on heats up to 10 hours duration. It should be borne in mind, however, that fluor spar has about double the fluxing capacity of limestone in making the substitution, so that for every pound of fluor spar added, two pounds of limestone should be deducted.

It has been found satisfactory to place the charge of flux directly upon the coke. The steel, having a higher melting point than pig iron, should be charged immediately after the limestone, and it should be followed, in turn, by the pig iron and the remelt. The metal charge should be carefully leveled by filling the smaller pieces of the remelt into the crevices left in placing the pig iron.

More coke will be used in melting semisteel than is used in good gray iron practice, as the semisteel must come from the cupola extremely hot. Having a much lower carbon content, semisteel freezes at a higher temperature, and therefore needs to be handled at a higher temperature than gray iron. For the same reason, it should be handled rapidly and in large ladles to prevent too great a fall in temperature.

The great variation in composition, between the steel scrap used and the balance of the charge, necessitates a thorough mixing of the metal before pouring. To this end, it is advisable to make the charges as small as is consistent with pronounced separation of the layers of coke and metal in the cupola. This feature is also governed, to some extent, by the ability of the charging gang to maintain proper charging conditions. The smaller the charge the greater is the difficulty in keeping the materials properly placed and the cupola full, so that it may become necessary to use slightly larger charges than would otherwise be desirable for the sake of maintaining the best charging conditions, especially in the case of heats of long duration. A cupola lined to 66 inches, operated very successfully on a 2000-pound metal charge so long as the heats were of short duration but when the time was increased materially, it was found necessary to double the charge, using 4000 pounds of metal. In order to maintain proper mixing of the metal, a large mixing ladle is advisable, as well as large pouring ladles.

A good melting practice for semisteel demands coke of good quality and a bed charge approximately 36 inches above the top of the highest tuyere opening. The coke charges between the charges of metal should be in the ratio of from 1 to 8 or 1 to 7.

Owing to the inferiority of the first metal drawn from the cupola, it is advisable to pig the first ton or two of metal melted. The reason for the inferiority of this metal can probably be attributed to several causes; among these are the greater oxidation, resulting in a low and uncerain manganese and silicon content and the tendency of the gray iron to melt ahead of the steel. It is, therefore, advisable to make separate analyses of the first metal, which is pigged for remelt, and to treat it as a separate constituent in calculating the mixtures. In order to render the variation in this first metal as small as possible, the steel scrap used on the first charge should be in as small pieces in order that it may melt as nearly as possible at the same time as the gray iron. After the first ton or two of metal has been tapped into the mixing ladle, the cupola should be plugged and the ladle drained so that the subsequent metal will not be contaminated with the first metal drawn. When the metal is again tapped, it may be allowed to run continuously and the molten metal drawn from the mixing ladle into the pouring ladle as required.

The blast should be maintained at a uniform volume and of sufficient quantity and pressure to penetrate to the center of the melting zone. A satisfactory pressure for a cupola lined to 66 inches has been found to be from 14 to 16 ounces, when this pressure was maintained approximately 30,000 cubic feet of air per ton of metal melted was supplied to the cupola.

In regard to manipulation of semisteel during and after pouring, it is sufficient to state that standard foundry practice consistent with the best results in gray iron should be maintained.

Study Effect of Sulphur and Phosphorus

A COMMITTEE has been appointed through the efforts of the American Society for Testing Materials, the U. S. bureau of standards and the U. S. railroad administration, to investigate the effects of sulphur and phosphorus on steel. The personnel of the committee is as follows: Bureau of standards, represented by Geo. K. Burgess and H. L. Whittemore, Washington; U. S. railroad administration, represented by F. M. Waring, Pennsylvania railroad, Altoona, Pa., and H. E. Smith, Washington; American Society for Testing Materials, represented by Robert W. Hunt & Co., New York, and T. D. Lynch, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; Society of Automotive Engineers, represented by E. F. Gilligan, Henry Souther Engineering Co., Hartford, Conn.; Association American Steel Manufacturers, represented by E. F. Kenney, Midvale Steel Co., Philadelphia, and J. J. Shuman, Jones & Laughlin Steel Co., Pittsburgh; Steel Founders Society of America, represented by J. E. McCauley, Birdsboro Steel Foundry & Machinery Co., Birdsboro, Pa.; U. S. war department, represented by F. G. Langenburg, Watertown arsenal, Watertown, Mass.; U. S. navy department, represented by D. J. McAdam, naval engineering experiment station, Annapolis, Md.; U. S. shipping board, represented by Frank Gentles, Philadelphia; National Research council, represented by John H. Hall, Taylor Wharton Iron & Steel Co., Highbridge, N. J.

Dr. George K. Burgess is chairman of the committee and the secretary is C. L. Warwick, secretary-treasurer of the American Society for Testing Materials, Philadelphia.

A program of tests has been outlined, which covers several different classes of rolled materials as well as forgings and castings. The tests are divided into two series designated *A* and *B*. In each series all factors will be kept as constant as possible with the exception of either the sulphur or the phosphorus. One of these elements will be varied in each series while every other element in the series will be held as constant as possible.

The ranges of phosphorus and sulphur in series *A* extend up to 0.08 per cent, and the sulphur in the steels of this series is to be *residual sulphur*, that is, sulphur present in the steel through fuel or from pig iron or scrap. Series *B*

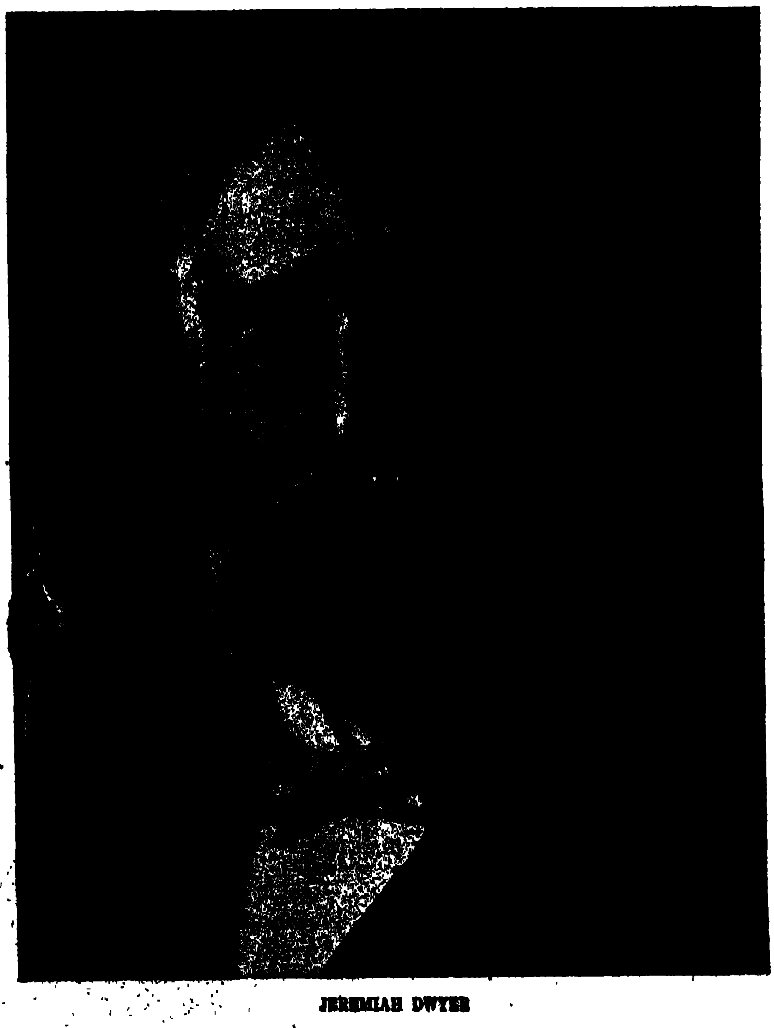
(*Concluded on page 167*)

Jeremiah Dwyer, Pioneer Stove Man, is Dead

JEREMIAH DWYER one of the pioneers of Detroit and moving spirit in the creation of one of the largest group of stove manufacturing plants in the world, died at his home early Thursday morning, Jan. 29, after a long illness. In accordance with his wish he was borne to his grave Saturday morning by eight of his old employes, a fitting end for one who started his career as a molder and climbing to the top of the ladder of success never lost touch with those in his service. Jeremiah Dwyer's career was typical of the industrial growth of the city of his adoption, it has been equalled perhaps by some but surpassed by few in rapidity of rise, or in qualities of courage, industry and vision. He was born in Brooklyn, N. Y., Aug. 22, 1838, the eldest son of Michael and Mary (O'Donnell) Dwyer who came to America from Ireland about the year 1818, settling near Hartford, Conn., later removing to Brooklyn, N. Y., where the father was an extensive contractor. A few years after the birth of Jeremiah the family moved to a farm in the vicinity of Detroit. Educated in the public schools of that city the boy was forced at the age of 11 to assume the burden of the head of the family, his father having been killed in a runaway accident at that time. He worked at various occupations for a few years and then served an apprenticeship at the trade of molding at the old Hydraulic Iron Works. After becoming a journeyman molder he worked for some time in Troy, Rochester and Buffalo. Returning to Detroit in 1861 he started a stove foundry in company with his brother, James, under the name of J. Dwyer & Bro. This business was subsequently incorporated under the title of the Detroit Stove Works, which plant was built under Mr. Dwyer's supervision and is still doing business.

In his early days he made the stoves by day and peddled them to down town stores at night. The Civil war created a demand that extended his market. In 1871 with Francis Palms, M. I. Mills, Charles DuCharme, George H. Barbour, and others, he founded the Michigan Stove Co., becoming president of what is reputed to be the largest stove manufacturing plant in the world. The buildings cover 360,000 square feet of ground and give employment to 1500 people. Jeremiah and James Dwyer were responsible for the inception of what is known as the base-burner, now in universal use. Applying for a patent the Dwyers found themselves involved in a long and bitter legal fight with, the then, leading stove manufacturers of the country. Because of the lack of financial resources he was at one time threatened with financial ruin, but his final success in establishing his rights in the courts made him one of the leading figures in the stove industry.

Mr. Dwyer resisted all appeals of friends at different times to enter politics. He did however, serve on the Detroit board of estimates for two terms and for nearly 24 years was commissioner of the House of Correction. His business connections were wide and various in spite of the fact that overwork early compelled a semi-retirement from any day to day attention to the details of his interests. At the time of his death he was connected with the Michigan Stove Co.; the Peninsular Stove Co.; Art Stove Co.; Michigan Copper & Brass Co.; Ideal Mfg. Co.; Michigan Fire & Marine Insurance Co.; Peoples State bank; First and Old Detroit National bank and the Security Trust Co. He was a member of the Detroit and Country clubs. For several years he was one of the conferees representing the Stove Founders' National Defence association at the annual conferences between that body and the Iron Molder's union and always exerted a powerful influence in those meetings. Four years ago his health was so impaired that the end was expected but he rallied and improved to such an extent that he was not considered in imminent danger until within a few hours of his death. He is survived by four sons and one daughter: John M. Dwyer, vice president of the Peninsular Stove Co.; William A. Dwyer, president of the Art Stove Co.; Emmett Dwyer, one of the vice presidents of the Michigan Stove Co.; Grattan L. Dwyer and Mrs. James J Smith, of Cleveland



JEREMIAH DWYER

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Contents

A Little Oil Works Wonders

AT VARIOUS times men have been impressed by the exhausting nature of manual labor incident to foundry work and have cast about for mechanical devices which would perform operations more easily and readily. In other instances the motive has been to increase the output of the operator in a given period of time, rather than to render his work lighter. It should be realized in all cases where it is desired to introduce machinery for doing some specific piece of work that the change from hand methods will prove comparatively expensive. Therefore, the equipment must work satisfactorily after it has been installed if it is to pay the initial costs and meet the requirements for which it is intended. There have been instances where ideas have been brought into existence full-fledged, and developed into commercial possibilities with little or no experimenting. These instances form exceptions. As a rule every idea of this character has been conceived and brought forth in a nebulous state, requiring more or less experimental work on the inventor's part before it has been reduced to a working basis. In fact it is almost universally true that the co-operation of other men, with different viewpoints, has been required to round out the original idea and make it work.

Mechanical equipment designed for use in foundries has to meet more rigorous tests and operate under more adverse conditions than almost any other form of machinery. Joints, bearings, hinges and sliding parts are constantly subject to the deteriorating influences of an atmosphere saturated at times with smoke, steam and dust. The dust, too, is peculiarly abrasive. In molding machines, sand cutters and sand mixing and conveying machinery this condition is aggravated on account of the amount of loose sand which constantly accumulates on the parts not actually in motion. Unless constant vigilance is observed by those operating the machinery the sand will work into the bearings and other parts on which the smooth and efficient operation of the machine depends. This will result in slowing down production or will render the machine useless in extreme cases. No machine is absolutely fool-proof and no machine, no matter how carefully designed or how well it is adapted to the use for which it was designed and constructed can function unless it receives a reasonable amount of care and attention.

The two main requisites for operating machinery, especially foundry machinery, in an efficient manner, are cleanliness and lubrication. There are other details to be observed if maximum output is to be expected from the installation but if one or both of these main features are neglected the machine will prove a liability instead of an asset. One or more men, depending on the amount of mechanical equipment used, should be detailed to examine all machines once or twice each day and see that all working parts are properly lubricated. It also should be part of the inspector's duty to instruct the men operating each piece of machinery so that they understand how the machine functions and to impress on them that care on their part will result in smoother and steadier operation with a resulting increase in the pay envelope. In the last analysis, that is the most powerful argument that can be applied to induce care in handling machinery.

Trade Outlook in the Foundry Industry

TRANSPORTATION difficulties continue to annoy castings manufacturers. Deliveries of raw materials are improved over the latter part of January, but still are far from satisfactory. In the coke regions, cars are available for about 50 per cent of the demand, which is at least 20 per cent below the number which could be loaded, were the cars available. Iron shipments, too, continue to lag, both through traffic difficulties and car or motive power shortage.

Iron Demand Heavy

Tonnages of pig iron sold during the past two weeks have exceeded any similar period in the past six months. This condition has been practically universal. The mounting demand for basic grades has occasioned concern, especially among those foundries which have purchased from merchant furnaces which swung over from basic to meet the demand for foundry grades. Prices have continued to strengthen, the $40 mark has been reached and passed, with no sign of weaking even in last half demand. High silicon irons, and other special alloy grades, show a diminishing supply, particularly for the first half delivery. Pig iron production is improving. According to *The Iron Trade Review*, production of coke and anthracite pig iron in January was 3,017,192 tons continuing the gains shown by the two preceding months. This figure is 2,626,074 tons in advance of the total for December. This represents 97,328 tons per day or 12,617 tons per day gain over the last month of last year. The improvement is better shown by the fact that it is 14.9 per cent advance in one month. The merchant output for January was 715.055 tons as compared with 653,792 for December, an increase of 61,263 tons. This represents 23,066 tons per day, compared with 21,090 tons for the previous month, a gain of 9.37 per cent. The gain in number of stacks in blast is also significant of the acceleration in iron production. Fourteen merchant furnaces were placed in blast and five were banked or blown out, giving a net increase of nine for the past month.

Prices of Raw Materials for Foundry Use

CORRECTED TO FEB. 6

Iron

No 2 foundry, Valley	$40.00
No. 2 Foundry, Birmingham	40.00 to 41.00
No 2 Foundry, Chicago	40.00 to 42.00
No. 2 Foundry, Philadelphia	43.10 to 45.35
Basic, Valley	10.00 to 41.00
Malleable, Chicago	40 50 to 42.50
Malleable, Buffalo	11 25 to 42.25

Coke

Connellsville foundry coke	$7.00
Wise county foundry coke	8.25

Scrap

Heavy melting steel, Valley	$28.00 to 29 00
Heavy melting steel, Pittsburgh	29 00 to 29.50
Heavy melting steel, Chicago	25.75 to 26 00
Stove plate, Chicago	36.00 to 36.50
No. 1 cast, Chicago	44.00 to 44 50
No. 1 cast, Philadelphia	37.00 to 39.00
No. 1 cast, Birmingham	29.00 to 30.00
Car wheels, iron, Pittsburgh	41.00 to 42.00
Car wheels, iron, Chicago	39.50 to 40.00
Railroad malleable, Chicago	34.50 to 35.00
Agricultural malleable, Chicago	34.50 to 35.00

Orders Are Plentiful

Probably at no time previously in the history of the foundry industry, has the demand for castings been heavier. Eastern manufacturers are seeking to buy castings in the west, and western buyers are inquiring in the east for any available foundry capacity. During the past few months an unprecedented amount of new plant construction has been undertaken. Many foundry equipment manufacturers state that December excelled any previous month in their business experience in the volume of orders from foundries either for new construction or for plant extensions. In the face of building material scarcity, high prices, and the increased cost of construction labor, this expansion can mean only that the foundrymen in general feel that the present prosperity is well founded, that a continuation of the demand for castings may be expected, and that additional facilities are essential. It will be remembered that the present strong buying movement which has brought such unprecedented business to practically every class of the industry, started with the automobile manufacturers. Many have been of the opinion that the makers of passenger automobiles had overestimated their 1920 requirements and early February, following the show season, would see retrenchment and cancellation of castings orders. The contrary result is noted. The manufacturers in many cases have still further expanded their production schedules. With the daily average production of 12 representative automobile manufacturers 150 per cent greater during the latter part of 1919 than it was during the first few months, and every effort being expended to increase this output, the demand for automobile castings is explained. Transportation troubles are forcing many foundries in Michigan and northern Ohio to deliver castings by motor truck to automobile factories. Railway buying still hangs upon the decision of congress relative to the return of the roads. Repair work is plentiful. Larger malleable shops which specialize in railway work are filled to capacity with repair orders. Inquiries for some 10,000 cars in the Chicago district, probably will not be transformed into orders until some definite decision is made on the terms of the return to private ownership. Manufacturers of farm implements and machinery recently have completed a survey covering the probable needs for 1920. It is stated that the demand for this class of equipment will be fully 50 per cent larger in the present year than it was in 1919. This is based upon the plans to raise larger crops this year, the shortage of farm labor which must be replaced by machinery, and the buying power of the rural communities which has increased due to the high prices paid for last year's crops. This demand will be reflected in the foundry industry. In fact some makers of farm tractors, and a large manufacturer of plows with plants in a number of cities even at this time are seeking castings from outside foundries, although previously their own plants have supplied their demand easily. Home building, and new construction continue to support a strong demand for all classes of domestic castings. This is particularly true of plumbing fixtures. Nonferrous prices, based on New York quotations, follow: Copper, 18.25c; lead, 8.75c to 8.87½c; tin, 58c; antimony, 11.50c to 11.75c; aluminum, No. 12 alloy, producers' price, 31.50c and open market, 30c to 31.50c. Zinc is 8.75c, St. Louis.

Comings and Goings of Foundrymen

E. M. LEWIS, who for the past six years has been sales manager and later secretary-treasurer of the Hill and Griffith Co., Cincinnati, resigned from that company, Jan. 1, and since has become associated with the E. J. Woodison Co., Detroit, in the capacity of general sales manager. Mr. Lewis was born and educated in Cincinnati and obtained his early training in that city. His first connection was with the Procter & Gamble Co. shipping department. He remained with that company through several departments, for about eight years. Later, he was superintendent of one of the largest maraschina cherry preserving plants in the country, and following this he took up expert accounting work with Ernst & Ernst. He left there to become associated with the Hill and Griffith Co.

Paul R. Beardsley, secretary-treasurer of the Piston Ring Co., Muskegon, Mich. has been elected mayor of that city.

E. L. Krome, formerly machine shop superintendent, American Blower Co., Detroit, has been made foundry superintendent.

R. B. Fisher, assistant to the president of the Buda Co., Harvey, Ill., has been made general sales manager for domestic and foreign sales.

J. H. James, formerly assistant manager, Monarch Steel Castings Co., Detroit, has been appointed foundry superintendent of the Foundry & Machine Products Co., Detroit.

Arthur G. Henry, metallurgist for the Illinois Tool Works, has become special representative for the Vanadium Alloy Steel Co., Latrobe, Pa., with offices at 566 West Randolph street, Chicago.

Albert Fagle, formerly machine shop superintendent of the Advance-Rumley Co., Battle Creek, Mich., has been appointed general superintendent of the plant, succeeding W. D. Creque.

Charles D. Steinmeyer, for many years connected with the Nordyke & Marmon Co., Indianapolis, as foundry superintendent, has joined the western sales force of the American Foundry Equipment Co.

Thomas N. Burman, formerly associated with the Hammer-Bray Co., Oakland, Cal., manufacturers of light gray iron castings, is now affiliated with Dow-Herriman Co., engineers and founders, San Francisco.

George S. Winner, general manager of the Cleveland Rubber Mold & Foundry Co., has been elected treasurer of the company. He will assume his new duties in addition to those of general manager.

J. M. Moore, who resigned as foundry superintendent of the Russel Wheel & Foundry Co., Detroit, Mich., over a year ago to accept a similar position with the American Blower Co., of that city, has resigned his latter connection and returned to the Russel Co., in his old capacity.

M. A. Beltaire Jr. has been placed in charge of the Detroit office recently

E. M LEWIS

opened at 805 Hammond building by the Booth Electric Furnace Co., Chicago. A branch office also has been opened in the Brown & Marx building, Birmingham, Ala., in charge of Gassman & Cunningham.

Frederick A. Merliss has been elected vice president and appointed manager of sales for the United Smelting & Aluminum Co., Inc., New Haven, Conn. He has been connected with the company for the past three years as assistant secretary and his appointment fills the place left vacant through the resignation of L. M. Brile.

C. E. Boyd, formerly connected with Timken-Detroit Axle Co., Canton, O., and recently foundry superintendent of the Saginaw Malleable Iron Co., Saginaw, Mich., has been made new manager of Marshall, Mich., plant of the Flint Foundry Co., which will be exclusively devoted to the production of automobile castings. The main plant and offices will continue at Flint, Mich.

M. T. Mortensen, formerly master mechanic and chief engineer of the Michigan Steel Castings Co., and Aluminum Manufactures, Inc., Plant No. 2, respectively Detroit, Mich., has resigned his last named connection and joined the city sales force of the J. W. Dopp Co., Detroit, Mich., representatives of foundry equipment manufacturers.

Hutton H. Haley, who has been affiliated with the Sand Mixing Machine Co., of New York City, in a sales capacity since 1911 and who as western district manager has handled the western sales of the succeeding company, the American Foundry Equipment Co., since 1915, has been made second vice president of the latter corporation.

Joseph E. Vincent Jr., 55 Liberty street, New York City, has been appointed eastern sales representative of the Massillon Steel Castings Co., Massillon, O., manufacturer of all kinds of steel castings, particularly those used in the automotive and railroad industries. He also represents the Peerless Drawn Steel Co., Schwart-Hermann Steel Works, Inc., and is an owner and general manager of the Iron, Steel, Metal & Alloy Co. In addition to the New York office a branch office is maintained at 120 Franklin street, Boston, in charge of C. H. Dayton, and within the near future an office will be opened in Philadelphia to supply the trade in Pennsylvania, Delaware and Maryland.

Acquires New Plant

The plant and business of the Buch Foundry Equipment Co., York, Pa., has been acquired by the American Foundry Equipment Co., New York, which is a recent consolidation of the Sand Mixing Machine Co. and the Rich[illegible]undry Equipment Co. R. S. Bu[illegible] who has been prominently identified with the molding machine industry for many years, will continue to be affiliated with the American Foundry Equipment Co. and will be in charge of the further development of his line of molding machine, flasks, etc., as well as their sale. The Buch plant at York, Pa., will continue to be operated until the new plant that is being erected by the American Foundry Equipment Co. at Chicago, is completed. It is the intention to concentrate all of the manufacturing operations of the American

Foundry Equipment Co. at this plant about May 1, which will afford 52,500 square feet of floor space and is being erected on a site at Forty-seventh street, near Kedzie avenue. When this plant is completed the works at Cleveland and York, Pa., as well as the existing Rich plant in Chicago will be dismantled.

Study Effects of Sulphur and Phosphorus

(*Concluded from page 162*)

is designed to carry higher sulphur than can usually be obtained as residual sulphur. In this series sulphur may be added during the latter stages of manufacture. The committee has decided to study first the effect of sulphur inasmuch as this presents the most urgent economic problem.

Much interest has been shown in this investigation. The manufacturers in particular have given it their hearty support, having agreed to furnish the material necessary to conduct the investigation The government departments have offered the facilities of their laboratories for making tests, as have also the manufacturers and several of the large railroads which have been approached. The various interests represented on the joint committee have agreed to assume such expenses of the investigation as arise naturally in the course of their participation therein, so that up to the present the joint committee has not found it necessary to raise a general fund for this purpose. Although the committee has been formally in existence only for some two months, it has made a good beginning. The following committees have been appointed:

Committee of statistics, H. L. Whittemore, chairman; committee on manufacture, Geo. K. Burgess, chairman; committee on tests, F. C. Langenberg, chairman.

A combination spray can and mold dryer has been put on the market by W. A. Roedell, Kingstown, N. Y. This dryer will burn either fuel oil or kerosene. It will operate on from 10 to 25 pounds of compressed air.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Benton Harbor Malleable Foundry Co, Benton Harbor, Mich., plans the erection of a power plant

The Dover Mfg Co., Dover, O, is making some extensions to its foundry.

The Hudson Brass Co., Brooklyn, N Y, is reported planning to build a plant at Ogdensburg, N Y.

The Strong Steel Foundry Co, Buffalo, is reported planning the erection of an addition to its plant.

Erection of an addition to its foundry, is contemplated by the King Foundry, St. Joseph, Mo.

The Reading Stove Works, Canal street, Reading, Pa., plans alterations and repairs to its plant.

The Diversey Foundry Co, Chicago, is reported planning the erection of a foundry at Janesville, Wis.

The General Fire Extinguisher Co., Warren, O., is getting a site ready for the erection of a modern gray iron foundry.

The Anderson Foundry & Machine Works, Anderson, Ind., is reported planning the erection of an addition to its plant.

Peter Peterson, Muskegon, Mich., has leased the plant of the Foote Axle Burr Co at Marshall, Mich., and plans to utilize the building for a brass foundry.

The North Buffalo Foundry Co., 747 Hertel avenue, Buffalo, contemplates the erection of a foundry, 70 x 100 feet.

The Niagara Pattern & Model Works, 1453 Niagara street, Buffalo, is reported planning the erection of a pattern shop.

Erection of an addition to its plant, is contemplated by the J. W. Pohlman Foundry Co., Buffalo. The building will be 59 x 92 feet.

Reus Bros., 146 W. Mt. Royal avenue, Baltimore, is having plans drawn for the erection of a foundry, 100 x 200 feet.

Erection of an addition to its foundry, to be 100 x 110 feet, is being planned by the Raritan Foundry Co., Raritan, N. J.

Capitalized at $25,000, the Campbell Stove Co. recently was incorporated at Rutherford, N. J., by William Bell, Colin Campbell and F. W. Conklin.

Erection of an addition to its plant is being planned by the Globe Malleable Iron & Steel Co., 101 Greenway avenue, Syracuse, N. Y.

Heggem & Davis, 624 Kennedy building, Tulsa, Okla., plan to erect a foundry and machine shop at Collinsville, Okla., each building to be 90 x 100 feet.

Capitalized at $100,000, the Adams Foundry & Machine Co, Youngstown, O, recently was incorporated by F. G. Friedrich, John Salato and others.

Capitalized at $10,000, the Active Castings Co., Detroit, recently was incorporated by Joseph C. Green, 788 Seminole avenue, and others.

The Stoke Foundry Co, Coldwater, Mich., recently was chartered with $100,000 capital, by Samuel D. Strong, and others

Work is expected to start shortly on the erection of a plant, to include a machine shop and foundry, for the Iowa Machine Works, Clinton, Iowa.

The Saco-Lowell Shops, Biddeford, Me., has let the contract for the erection of a foundry and a 5-story, 38 x 300 foot storehouse.

The capital stock of the Buckeye Castings Co, Lima, O, recently was increased from $10,000 to $25,000.

Capitalized at $100,000, the Cuyahoga Foundry Co, Cleveland, recently was incorporated by E Knapp, V. Foukal and others

The A. Plamondon Co., Chicago, J T Benedict, president, 24 North Clinton street, is building a foundry and machine shop, 200 x 500 feet.

Bids have closed for the erection of an addition to the foundry and machine shop at the Charlestown navy yard.

William E Harmer and Frank Clark, Franklin, Pa., will rebuild the plant of the Venango Bronze & Metal Co.

The capital stock of the Cincinnati Aluminum Castings Co, Cincinati, recently was increased from $20,000 to $75,000.

Fire recently damaged the plant of the Grey Foundry Co., Church and Esplanade streets, Toronto, Ont.

The W. A. Mills Brass Co., Port Chester, N. Y., recently was reorganized with an active capital of $150,000.

The Barcalo Mfg. Co., 225 Louisiana street, Buffalo, manufacturer of brass and metal beds, has increased its capital from $300,000 to $1,000,000.

The Indianapolis Stove Co., Indianapolis, is having plans prepared for the erection of an addition to its foundry.

The Pennsylvania Casting & Machine Co., Keystone building, Pittsburgh, is considering the erection of a 2-story building, 29 x 39 feet.

The capital stock of the Wisconsin Aluminum Foundry Co., Manitowoc, Wis., recently was increased from $100,000 to $200,000, and plans are being prepared for the enlargement of the company's plant.

The Central Mfg. Co, Kalamazoo, Mich., contemplates the erection of a plant to include a brass smelting room.

The Campbell, Wyant & Cannon Foundry, Muskegon, Mich, contemplates the erection of a plant addition.

Erection of a plant addition is reported being contemplated by the Lakey Foundry Co., Muskegon, Mich.

A gray iron foundry, 100 x 150 feet, will be built by the Iron Products Corp., La Crosse, Wis. Plans are now being prepared for the building.

The Euclid Foundry Co, Euclid Village, O., recently was incorporated with $100,000 capital, by C. Yanchar, J. Kubiese, Joseph Pogric and others.

The Bessemer Gas Engine Co., Grove City, Pa., has purchased land on which it plans the erection of a foundry and pattern shop. It also plans to erect 50 dwellings for its employes.

The Pulaski Foundry & Mfg. Co., Pulaski, Va., recently increased its capital from $50,000 to $150,000, and is reported having plans prepared for doubling its capacity.

Organization of the New Process Foundry Co., 165 South Rio street, Los Angeles, recently was effected, by William Walsh and others, and the company will engage in the manufacture of castings.

The McCoy Bronze Co., Detroit, has been incorporated with $40,000 capital, by J. E. McCoy, 206 Mt. Vernon avenue, and others, and will engage in the manufacture of bronze, brass and copper products.

Lockwood, Greene & Co., Boston, are drawing plans for the erection of a foundry addition and office extension for the Crosby Steam Gauge & Valve Co., Charlestown, Mass.

The Griffith Foundry Co., Griffith, Ind., recently was incorporated with $50,000 capital to engage in the manufacture of iron products, by H. C. Stuart, C. F. Holt and S. E. Stuart.

The Champion Foundry Co, Piqua, O., has been incorporated with $50,000 capital, by J. E. Bryan, Charles L. Hinsch, C. F. Stickler, L. A. Frazier and Maurice Wolfe.

The Economy Brass Mfg. Co., Cincinnati, has been incorporated with $20,000 capital, by M. Bachrach, W. E. Rutter, P. P. Bundman, Joseph Matthew Pfeiffer and Louis Katz.

The J. E. Steinmeier Bronze Works, New York,

castings, with $25,000 capital, by J. E. and L. M. Steinmeier and E. H. Fitch, 2694 Valentine avenue.

The American Stove & Range Co., Minneapolis, has bought a site at East St. Louis, Ill., on which it is reported planning to erect a modern stove foundry.

The Lynchburg Foundry Co., Lynchburg, Va., has awarded a contract for the erection of an addition, 120 x 230 feet, to be equipped as a pipe shop and foundry.

The Greenville Iron Works, Inc., Greenville, S. C., founder and machinists, has purchased property on which it plans to build an additional foundry and machine shop.

H. E. Beck and William Gallagher, Dennison, O., are reported planning to organize a company which will engage in business at Uhrichsville, O., as a founder and machinist.

The M. A. Love Mfg. Co., founder and machinist, and the Ward Pump Co., both of Rockford, Ill., are reported planning to consolidate as the Ward-Love Pump Corp., with a capital of $1,500,000.

The Illinois Foundry & Specialty Co., Morris, Ill., has purchased the Hart foundry at the foot of Hancock street, Peoria, Ill., which it will put into operation.

Contractors are completing the erection of a foundry for the Blackmer Rotary Pump Co., Petoskey, Mich., which will be devoted to the manufacture of pump castings.

L. R. Bliss, C. F. Bliss and F. N. Ames recently were named as the incorporators of the American Castings Co., which was chartered with $60,000 capital, at Corry, Pa.

Plans are being prepared for the erection of an addition to the iron and brass foundry of the Gilbert & Barker Mfg. Co., West Springfield, Mass. The building will be 40 x 400 feet.

The Chas. Jurack Pattern Works, Milwaukee, recently increased its capital from $50,000 to $150,000, in order to finance the equipping of a plant extension.

The White Metal Mfg. Co., 1006 Clinton street, Brooklyn, N. Y., is having plans prepared for the erection of a plant to include a main 6-story building, 35 x 135 feet, and a 2-story foundry, 20 x 80 feet.

The Accurate Brass Casting Co., Brooklyn, N. Y., which was recently formed, is said to be planning the erection of a foundry, 80 x 90 feet. Brass as well as other metal castings will be manufactured.

The Novo Engine Co., Lansing, Mich., has started on a large building expansion program, calling for additions and increased equipment. A foundry addition, 120 x 280 feet, and a machine shop, 90 x 280 feet, are under construction.

The Royal Brass Foundry Mfg. Co., McWhorter street and New York avenue, Newark, N. J., has been organized to manufacture brass, copper and other castings, by August C. Fuchs, 304 Oliver street, John Musto, 29 Bedford street, and others.

Plans have been prepared for the erection of a building, 80 x 200 feet, to be divided in three bays, the center one to be equipped with a crane, for the Hill-Curtis Co., Kalamazoo, Mich. The company is asking for bids for the erection of the structure.

The American Foundry Co., Milwaukee, is being organized and will have a capital of $100,000. Those interested in the company are planning to erect a gray iron foundry to be devoted to the manufacture of automobile castings, and a site has been purchased at Park and Ninth streets.

The East Hampton Foundry Co., East Hampton, Conn., which started business last spring, recently incorporated, and changed its name to the Valley Foundry Co., Inc. The company has a capital of $50,000, and plans to build a new foundry, 50 x 110 feet with an extension, 28 x 60 feet. It will do light work up to 1000 pounds.

Proceeds from the sale of new stock being issued by the Cincinnati Steel Castings Co., Cincinnati, will be used to build an extensive addition to its molding department. Two electric furnaces will be installed. The company is increasing its capital from $50,000 to $100,000 and has acquired two acres adjoining its plant, upon which several foundry buildings will be erected in the future.

Plans have been completed by Engineers for the erection of an extension to the foundry of the Perkins Corp., Mishawaka, Ind., manufacturer of wind mills, towers, pumps, well supplies and gray iron castings. When completed it will double the capacity of the plant. C. A. Carlisle is president.

The Vulcan Foundry Co., 33 Hermon street, Worcester, Mass., which was formed to manufacture brass and bronze castings with $10,000 capital, operates a foundry in the rear of 35 Hermon street, and contemplates the installation of an additional cupola for the production of iron castings. Robert J. Molt, Samual Seder and G. W. Wood are the incorporators of the company.

The Homer Furnace Co., which recently removed its business from Homer, Mich., to a large new plant at Coldwater, Mich., is erecting a foundry, 128 x 150 feet, for the use of the Strokel Foundry Co. The latter company was recently organized to produce jobbing castings and has started operations in a part of the Homer plant. The foundry to be built will form an addition to the plant of the Homer Co.

The increase in business of the H. Kramer & Co., Chicago, has been so rapid, that the company has found its new plant at 1324-44 West Twenty-first street, into which it recently moved, too small for the heavy demands for its products, and have purchased 25,000 square feet of land adjoining its plant, on which it will erect an addition to its foundry. The addition will be equipped with a large cupola, 25 pit furnaces, four large reverberatory brass and dross furnaces, 15 white metal kettles, extra tables and concentrating department, as well as many other modern improvements.

New Trade Publications

SAND CUTTER.—The American Foundry Equipment Co., New York, is circulating a folder, containing a list of foundries which use its sand cutters.

HOISTS.—Electric hoists, overhead traveling cranes, revolving locomotive cranes, electric telphers, etc., are described and illustrated in a booklet recently published by the Link-Belt Co., Chicago.

ARC WELDING.—The U. S. Light & Heat Corp., Niagara Falls, N. Y., is circulating a bulletin in which electric arc-welding equipment is described and illustrated. The booklet also contains a number of characteristic curves.

FOUNDRY EQUIPMENT.—The Northern Engineering Works, Detroit, is circulating an illustrated booklet, in which general foundry equipment, including cupolas, cranes, ladles, etc., are described and illustrated. Detailed information concerning the various items is given as well as specifications, etc.

FOUNDRY EQUIPMENT.—The W. W. Sly Mfg. Co., Cleveland, is circulating a large cardboard folder, in which recent foundry installations, including a cupola, core ovens, sand blast rooms, dust arresters, exhaust mills and sand blast mills, are described. The descriptions are accompanied by illustrations.

LABOR-SAVING EQUIPMENT.—A booklet of 108 pages is being circulated by the Link-Belt Co., Chicago, in which freight and package handling machinery and other labor saving devices, such as elevators and conveyors, is described and illustrated. The booklet is profusely illustrated, showing the various uses to which this equipment is adapted.

ENGINEERING SERVICE.—An illustrated booklet has been published by the Service Engineering Co., New York, in which details of engineering service rendered by the company and covering plant and machine tool appraising, planning, complete tooling systems, design and building of tools, special and automatic machinery and the development of inventions, is discussed.

ELECTRIC CRANES.—A bulletin recently was issued by N. B. Payne & Co., 25 Church street, New York, agents for the Lane Mfg. Co., Montpelier, Vt., describes and illustrates several styles of cranes in which steel girders or heavy timbers are used. The bulletin contains a complete set of specifications and a list of users. A questionnaire is inserted in the bulletin for the use of prospective buyers.

INDUSTRIAL GLOVES.—Gloves and mittens for use in industrial plants are described and illustrated in a booklet being distributed by the Industrial Gloves Corp., Chicago. These gloves and mittens are long fiber chrome tanned leather and are sewed with steel thread. Parts of the glove which come in contact with wear are reinforced with small ribbons of steel, clinched through the leather, in such a way that they can not hurt the hand or come loose. Other data are given in the booklet.

MAGNESITE.—The Northwest Magnesite Co., Chewelah, Wash., has published an illustrated booklet containing information about the company's history, the manufacture of magnesite, its use. The first section of the booklet gives the history of the company. The second section describes the company plant and deposit and a third section is devoted to describing methods for microscopic examination, which is accompanied by a number of colored plates, illustrating magnified sections of magnesite brick.

CRANES.—Cranes adapted for machine shop or similar service are described in a 16-page illustrated booklet recently published by the Toledo Bridge & Crane Co., Toledo, O. In these cranes, the trolley sides are I-beam or box sections and constructed of semisteel or cast steel. The sides are joined by a builtup cross girt. The drums are gray iron and all gears are machined turned and cut from open-hearth steel castings. Other details are given and the illustrations give the reader a comprehensive idea of the crane.

GRINDERS.—An interesting booklet known as "The Operator's Handbook for the Blanchard High Power Vertical Surface Grinder," has been published by the Blanchard Machine Co., Cambridge, Mass. The booklet, which comprises 62 pages, offers information concerning grinders manufactured by the company, and contains instructions as to the care of these machines as well as operating details. The booklet has been prepared in a thorough way, and should be of particular interest to tool designers, machinists, etc., as well as production managers.

DERRICKS.—Derricks and locomotive cranes are described and illustrated in a 40-page booklet prepared by the Edward F. Terry Mfg. Co., New York. The derricks described include guy derricks, stiff-leg derricks, barge derricks and jinniwink derricks. Various [illegible]s of the derricks are also described and illustrated and complete specifications given. Hoisting engines, contractor locomotive cranes, and cranes designed for various other work, are also described and illustrated in the booklet. The last few pages of the book contain illustrations of actual crane and derrick installations.

HEAT TREATING FURNACES.—The McCann-Harrison Co., Cleveland, has published two circulars in which two types of heat treating furnaces are described and illustrated. One folder is devoted to a description of a heavy underfired heat treating furnace. This furnace has a heavy cast iron and steel front, with steel plates and buckstays on sides and end. It is equipped with oil, gas or combination burners. The second folder describes a medium underfired heat treating furnace, which has a large combustion chamber and flue space under the hearth. The unit has a cast iron, and steel front, with steel plates and buckstays on sides and can be equipped with oil, gas or combination burners. Line drawings of both furnaces are given.

THE FOUNDRY

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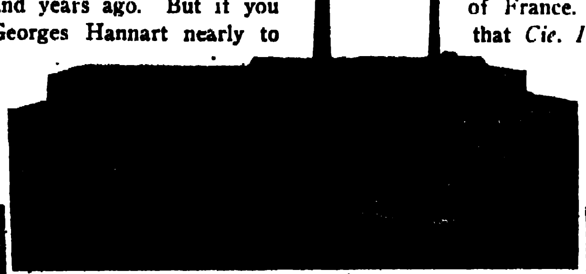
I. H. C. Foundries in France Rebuilt

How the Casting Shops in the Factory of the International Harvester Co. Near Lille Have Been Re-equipped and Again Organized for Operation After Four Years of War

BY H. COLE ESTEP

CROIX-WASQUEHAL near Lille with its quaint streets and red brick houses overhanging the sidewalks, breathes the very spirit of an old French village. And although scarred with the tragic aftermath of the great war, its life has again fallen into the old grooves with the wooden shoes clicking over the cobblestones much as they did a thousand years ago. But if you follow them down the Avenue Georges Hannart nearly to the Rue de Wasquehal, and turning into the main gate of the big works of the *Compagnie Internationale des Machines Agricoles* bear sharply to the right into the gray-iron foundry you find yourself suddenly transplanted four thousand miles into the heart of the United States. Here is an American foundry with American equipment, methods and atmosphere turning out some fifty tons of castings a day in the north of France. The explanation lies in the fact that *Cie. I. des Machines Agricoles* is the French pseudonym for our own International Harvester Co., with its headquarters at Chicago and numerous plants throughout the

The author, H. Cole Estep, is European manager for THE FOUNDRY.



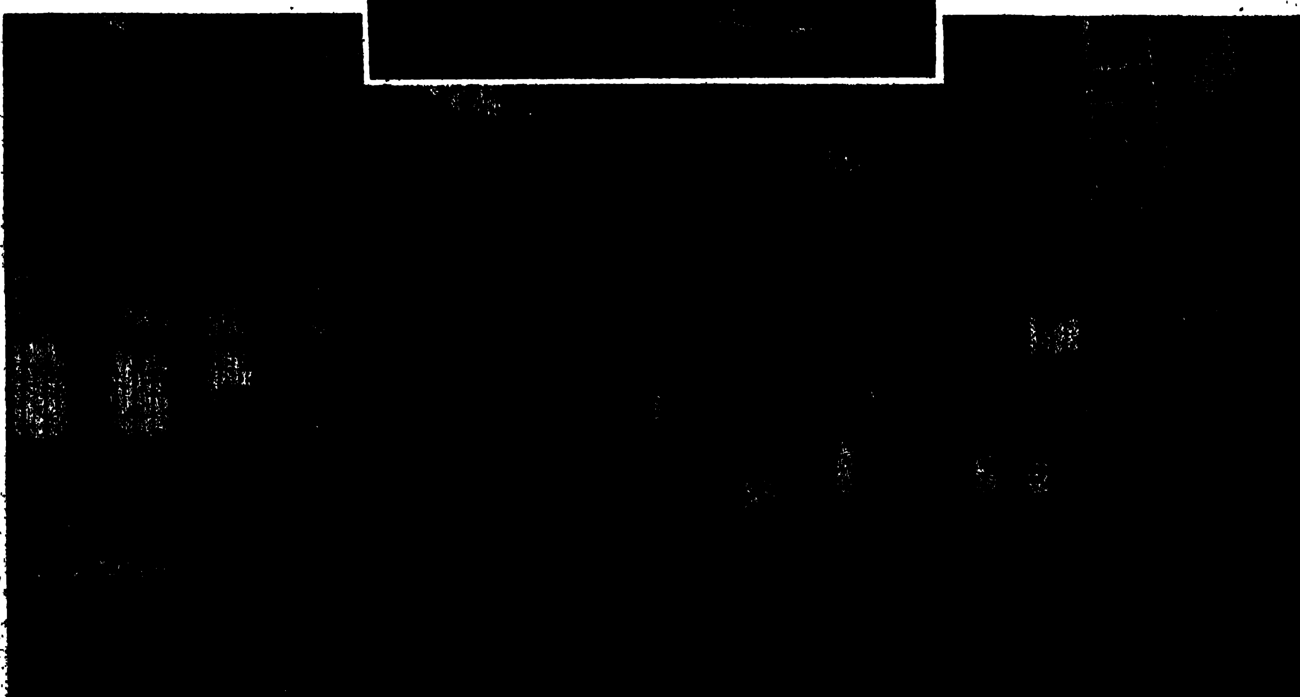


FIG. 1 (ABOVE)—MALLEABLE CASTINGS FOR THE CROIX-WASQUEHAL PLANT ARE MADE IN THIS MODERN STRUCTURE FIG. 2 (BELOW)—THE GRAY-IRON SHOP WAS CONVERTED INTO A MILL FOR ROLLING CORRUGATED SHEETS FOR TRENCH CONSTRUCTION

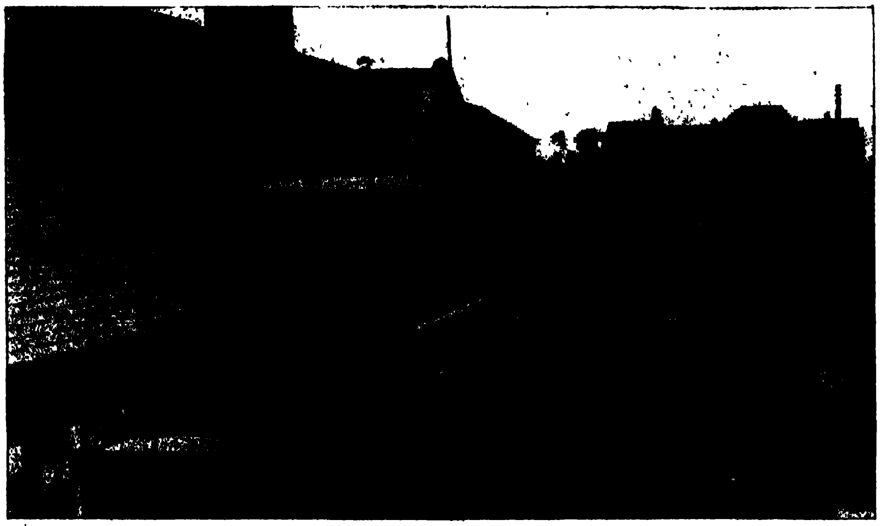


FIG. 3—THE YARD ALONGSIDE THE GRAY IRON SHOP SHOWING CHARGING-FLOOR ELEVATOR

United States. The foundry at Croix is a part of one of the several factories owned by the International Harvester Co. in Europe, in Russia, Germany, France and Sweden respectively What happened to them all in the last five years may readily be imagined. The entire plant at Croix-Wasquehal was put out of action and almost completely stripped by the German army during the war It is with the technical features of the reconstruction and methods of operating its two foundries, for there is a malleable shop in addition to the gray iron foundry, that it is proposed to deal in this article These two shops have passed through the valley of the shadow of death and out again into abundant life. Herein lies a story, romantic in its setting and incident and instructive in its technical aspects.

The village of Croix-Wasquehal is in the department of Nord, France. The town in reality is a suburb of Lille with which it is connected both by steam and electric railroads. It is about four miles distant from the center of Lille For four years the front line lay only a few kilometers on the opposite of Lille from Croix The Harvester company's works was within the sound of guns all the time, but was not directly damaged by military action. The French company under whose auspices the plant is operated is capitalized at 5,000,000 francs, all of the stock, of course, is controlled by the parent company in the United States. The factory is equipped to build mowers, reaping attachments for mowers rakes, tedders, spring-tooth harrows, tongue trucks, etc., and to make binder twine and other miscellaneous agricultural implements and spare parts. The capacity of the plant under normal conditions is 75,000 machines a year, together with 9000 tons of binder twine. Prior to the war approximately 1600 employes were required including about 250 in the two foundries. The plant was built in 1910. It was practically new, therefore, at the time of the German invasion

As shown by the accompanying plan, Fig. 10, the factory as a whole occupies two irregular plots of ground separated by the Rue de Wasquehal and Avenue Georges Hannart. The two parts of the plant are connected by a covered bridge spanning the crossing of the two streets. This bridge joins the forge and machine shops. The total area occupied by the works, exclusive of streets, is 97,004 square meters or approximately 24 acres. In other words it is no small establishment.

The smaller of the two tracts into which the property is divided is occupied by the gray-iron foundry; a 2-story main building housing the machine-shop, woodworking and pattern shop, paint shop, assembly department, etc.; the boiler and air compressor house; pattern vault; and executive offices. On the larger plot of ground is the forge shop, pump house, warehouse, lumber yard, twine mill and malleable castings foundry. Plenty of room has been left for future expansion either by the extension

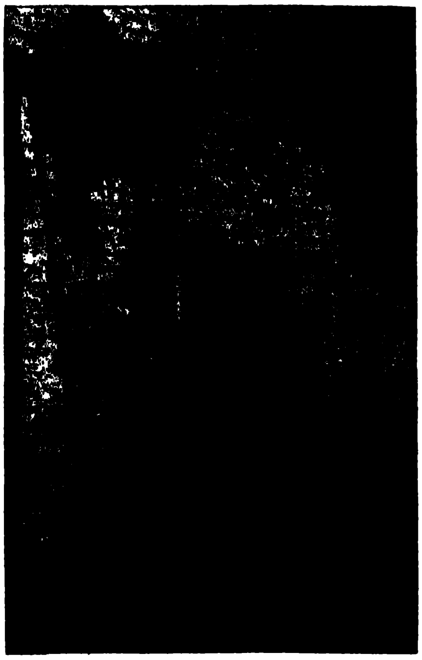


FIG. 5—IMPROVISED MOTOR CONNECTED TO TRIPLEX HOIST OUTSIDE FOR OPERATING CHARGING-FLOOR ELEVATOR

of existing units or the erection of new buildings. The gray-iron foundry may be doubled in size by erecting a new structure alongside the one now in use, and the malleable shop can be extended lengthwise in the direction of the lumber yard to nearly half again its present dimensions.

In addition to the covered bridge between the forge shop and main building, the various units in the plant are connected by standard gage railroad tracks which make it possible to spot cars wherever they may be required for bringing in raw materials, shipping finished products and intra-plant transportation.

The gray-iron foundry is 118 meters in length and 25 meters in width, or ap-

FIG. 4—THE CUPOLA-CHARGING FLOOR LOOKS LIKE A BIT OF THE U. S. A.

proximately 82 x 387 feet. The floor area is 31,725 square feet inside measurement. It is divided by two partitions into a cleaning room, molding room and core room in the order named. The molding floor area is about 22,200 square feet. A space about the size of the building itself has been left between the foundry and the fence bordering the Avenue Georges Hannart for the storage of raw materials. The pig iron and scrap are taken care of in open bins adjacent to the charging-floor elevator. The sand is stored in a series of brick bins built in the corner of the yard along a curved track as shown in Fig. 10. Another standard-gage track extends alongside the fence for the full length of the storage yard, while parallel to this track but snug against the building is a narrow-gage track for handling iron and coke buggies. At one end of the molding room are the two cupolas. The shop has a melting capacity of about 65 tons a day. The equipment, which includes a full complement of molding machines and other auxiliaries, is such as may be found in any modern casting shop in the United States. Only light castings are turned out and hand cranes therefore are employed. Liberal compressed-air facilities are provided and the machinery is driven by electric motors. The building itself is a steel frame and brick structure with ample window area.

FIG. 7 MOLDING MACHINES FITTED WITH MOWER-FRAME PATTERNS—ALL EQUIPMENT OF THIS SORT HAD TO BE THOROUGHLY OVERHAULED

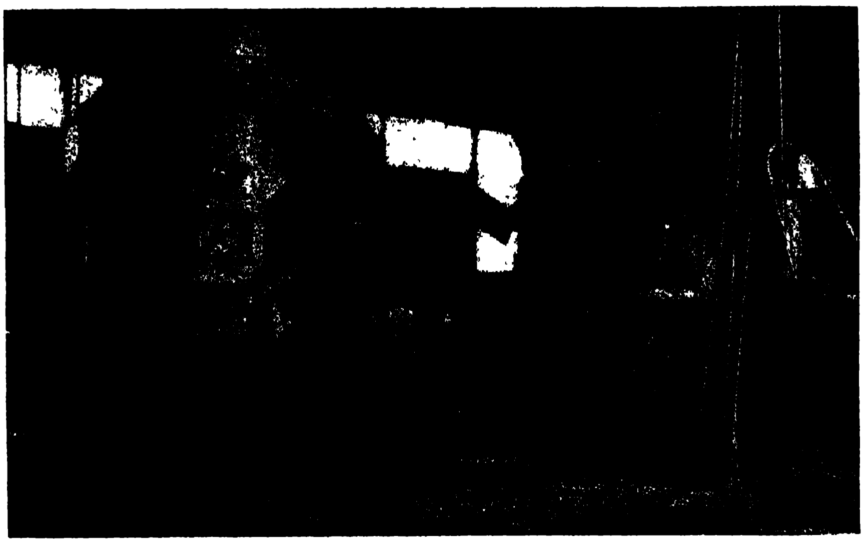


FIG. 6—THE CUPOLAS LOOK NATURAL BUT THE LADLE IS NOT AN AMERICAN TYPE

As shown in Fig. 10, the malleable shop is located at some distance from the gray-iron foundry. This arrangement, which has its disadvantages, is due to the later origin of the former shop. The malleable foundry is of standard monitor construction with 80 per cent of the wall space glass. Both this foundry and the twine mill nearby have more the appearance of American shop structures than any other buildings about the works. The building is 41 meters wide and 88 meters long, or 135 x 289 feet, the floor area being 39,256 square feet. It is divided by two partitions near the middle, leaving a combined melting and molding room at one end about 135 x 145 feet, with a hard-iron cleaning room 35 x 135 feet in the center, and a combined annealing, soft-iron cleaning and shipping room 109 x 135 feet at the opposite end. This arrangement is clearly indicated in Fig. 10, which also shows the location of the air and annealing furnaces with their respective stacks. The air furnace is rated at 12 to 15 tons per charge. It is of standard American design, operating under natural draft with a steel stack 98 feet high. There are two annealing furnaces connected to a 91-foot brick chimney, together with the usual equipment of tumbling mills, grinders, etc. This foundry turns out the usual American black-heart malleable instead of the white-heart product which is usually made in Europe. The shop is designed for an annual capacity of 4000 tons of small malleable castings.

With special reference to its foundries, the foregoing briefly describes the French factory of the International

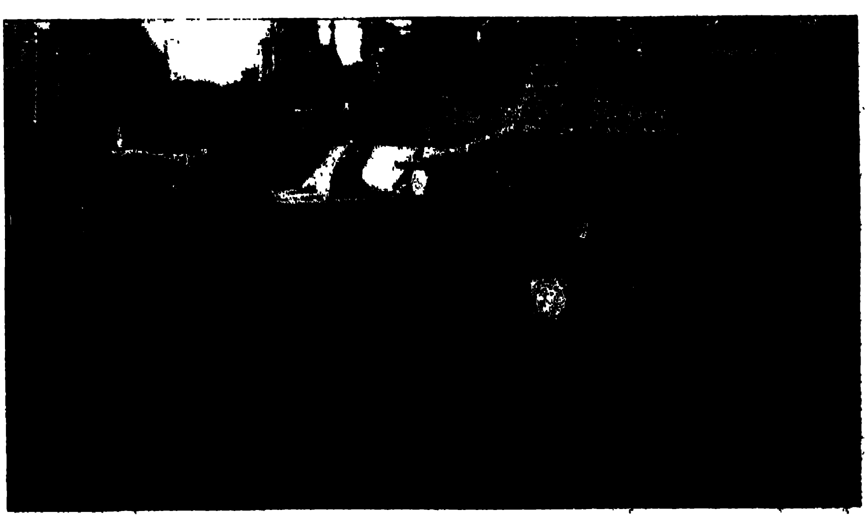
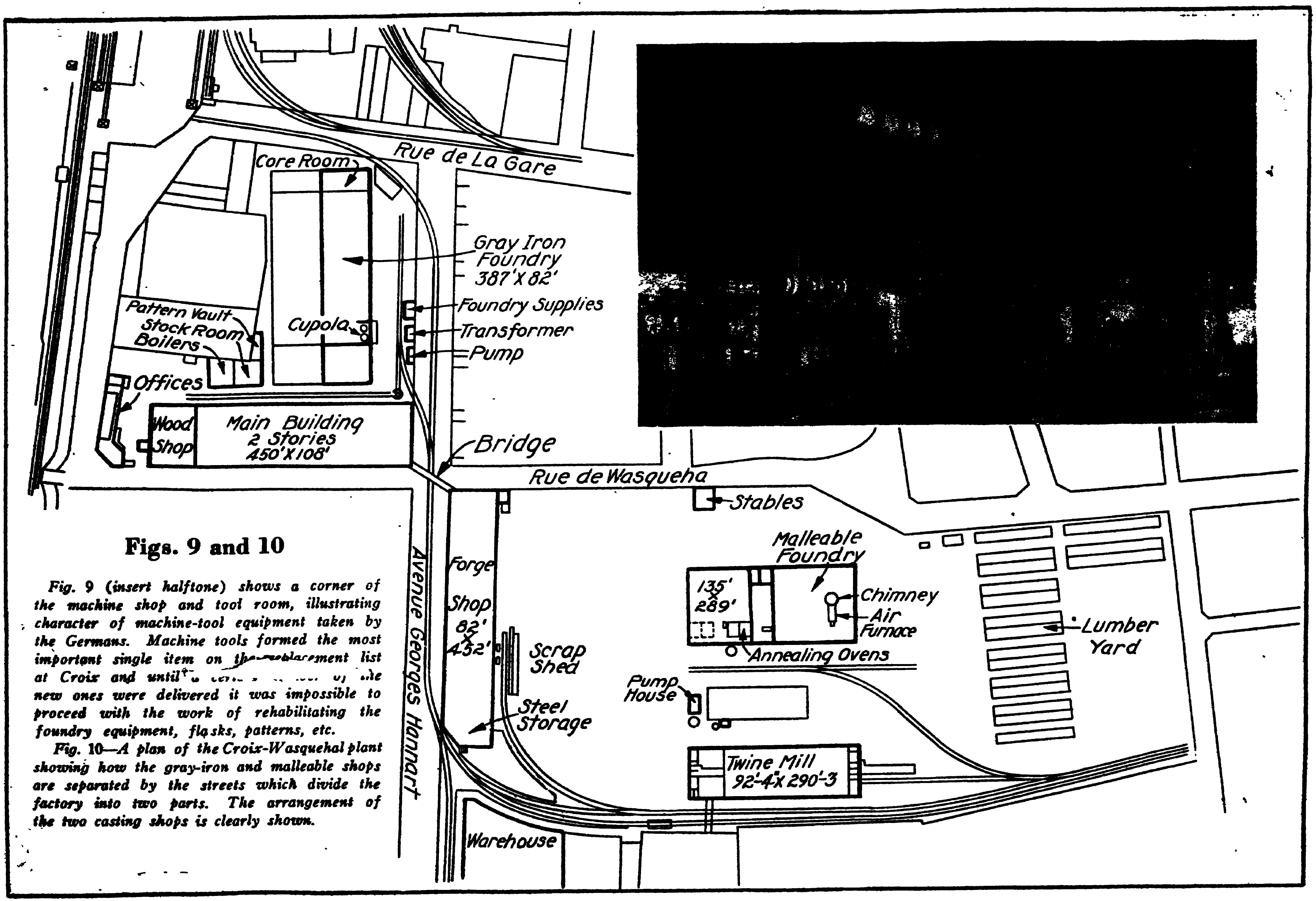


FIG. 8—A CORNER IN THE TOOL-ROOM DEVOTED TO MOLDING MACHINES, FLASKS AND PATTERNS



Figs. 9 and 10

Fig. 9 (insert halftone) shows a corner of the machine shop and tool room, illustrating character of machine-tool equipment taken by the Germans. Machine tools formed the most important single item on the replacement list at Croix and until [illegible] the new ones were delivered it was impossible to proceed with the work of rehabilitating the foundry equipment, flasks, patterns, etc.

Fig. 10—A plan of the Croix-Wasquehal plant showing how the gray-iron and malleable shops are separated by the streets which divide the factory into two parts. The arrangement of the two casting shops is clearly shown.

Harvester Co. as it was before the war —and is today.

During the war this great establishment was reduced to chaos. Its present satisfactory condition is the result of over 15 months' hard work and the expenditure of some $2,000,000. It is one of the few large "reconstructed" works in northern France. This means that in the interval since the liberation of Lille from the enemy in October, 1918, the entire plant has been completely re-equipped and renovated; a new stock of pig iron, scrap and other raw materials has been assembled, and an operating staff again gathered together. All this has been accomplished amid the chaotic conditions following the war, and in the face of serious difficulties, not the least of which was the lack of railroad facilities for bringing in new equipment and raw materials. It is not too much to say that American courage, initiative, energy, and willingness to make liberal investments to secure results, have scored another victory in Europe—on the very field of battle. In this effort the French population and government officials co-operated to the best of their ability, for the rebuilding of the Croix factory means independence and prosperity again to over a thousand families. This is a practical way to aid "starving Europe," and it involves not the giving away but the investment of Yankee dollars on a liberal scale.

No Simple Problem

While this article covers almost exclusively the technical problems encountered in rebuilding and operating the Harvester company's foundries at Croix-Wasquehal, it should be borne in mind that what was really dealt with was a far larger task. For while the plant itself was being reanimated, community life in the surrounding towns, without which no industry can exist, had to be gradually reconstituted. A people who for over four years had been ground under the heel of an absolutely ruthless invader had to be set going again. At the close of the war Lille, Turcoing, Roubaix, and Croix-Wasquehal were dead communities in which the people had been struggling for nearly half a decade against forcible deportations and other horrors for a mere existence. With the exception of water supply, even the elementary functions of municipal life had been suspended, including electric light and power, telephone service, street cars, etc. The trolley poles in fact were stripped bare of wire. But a recent visit to Lille found life moving in its accustomed grooves, with lights, music, even heat, and transportation. Much remains to be accomplished, it is true, but much has been accomplished. Those conveniences which we take for granted in the United States were totally lacking in November, 1918, while in December, 1919, normal, civilized life was in evidence on all sides. This phase of the situation is emphasized, because the extraordinary conditions under which the units of the Croix-Wasquehal harvester plant were rebuilt and set going again should constantly be kept in mind as a background against which the more or less conventional feats of engineering involved in the reconstruction operations can be thrown up in proper perspective.

Some Practical Hints

At the same time the experience of the International Harvester Co. should contain suggestions of practical value to other American manufacturers who may be contemplating the establishment of casting plants in Europe during the postwar period. Many of the difficulties and conditions encountered by the Harvester company were no different than would fall to the lot of anyone trying to convert a set of more or less dilapidated empty buildings into an operating property anywhere in western Europe.

Before taking up the reconstruction and operation of the Croix foundries in detail, their history under the German occupation should be presented.

The Croix plant was closed with the invasion of Belgium. The Germans entered in October, 1914. The removal of machinery and equipment actually began in May, 1915, and continued on an increasing scale throughout the duration of the war.

Saxon infantrymen occupied the foundry in the spring of 1916. As shown in Fig. 2, they converted it into a rolling mill for corrugating heavy trench protection sheets and other work, moving two of the heating furnaces from the forge shop for that purpose. The molding machines and other foundry devices were of course scattered about, although few appear to have been actually removed. No special large scale operations appear to have been attempted in this improvised rolling mill.

In neither of the foundries were there the bodily removals that took place in the machine shop, forge and twine mill, but this does not mean they were not seriously knocked about. Fig. 2 is evidence of the condition in which the Germans left the casting plants. In the gray-iron shop the cupolas and tumbling mills were left intact; the former probably were used. Also relatively few of the molding machines were taken, but nearly all the machines were displaced from their foundations, piled up indiscriminately and suffered severely through four years neglect. Every one had to be overhauled. This also applies to all other machinery the Germans chanced to leave behind.

The stock of pig iron, scrap and coke on hand when the plant was closed down in 1914 was either melted up or taken away. This also applies to new sand and other foundry supplies of all sorts. Finished castings were dumped outside and molding sand thrown on top of them—probably to make room for the rolling mill previously mentioned. The entire stock of flasks, metal patterns, etc., was either melted up or carried away. About 3750 cast-iron flasks have had to be replaced.

The invaders displayed less interest in the malleable foundry, but it suffered severely like the other units from four years neglect, disuse and employment as a stable.

The work of reconstruction started in December, 1918, but did not get in full swing until the spring of 1919. The task may now be said to be completed, although many details remain to be cleared up.

Preliminary Steps

Returning now to the technical details with which the staff of experts of the Harvester company was confronted in the re-establishment of its foundries on an operating basis, it was first necessary to make a complete survey of the situation as the enemy left it. This was done not only for purposes of general information, but to determine in detail what equipment was missing, what of that which remained could be repaired, and what new machinery would have to be obtained to make good the loss and damage. Replacements, taking the plant as a whole, formed by far the largest item, but in the foundries it was more a question of rehabilitating existing equipment, with the main exception of flasks, patterns and melting stock. With reference to new machinery, the engineers and executives on the spot had to decide whether it should be built at the works, as in the case of flasks and patterns; or purchased in France, as in the case of shafting, hangers, pulleys, motors, etc.; or imported from the United States, as in the case of machine tools. This procedure had to be gone through with respect to each item of equipment and supply in the whole establishment. The plant had to be refurnished from cellar to garret. This in its turn involved the repair of the buildings; the provision of power, light, heat and transportation facilities; the replacement or repair of all necessary tools and machinery; the acquirement of a new stock of raw material; and the assembly of an executive and working force.

In connection with the purchase of new equipment it was necessary in each case to decide whether it should be

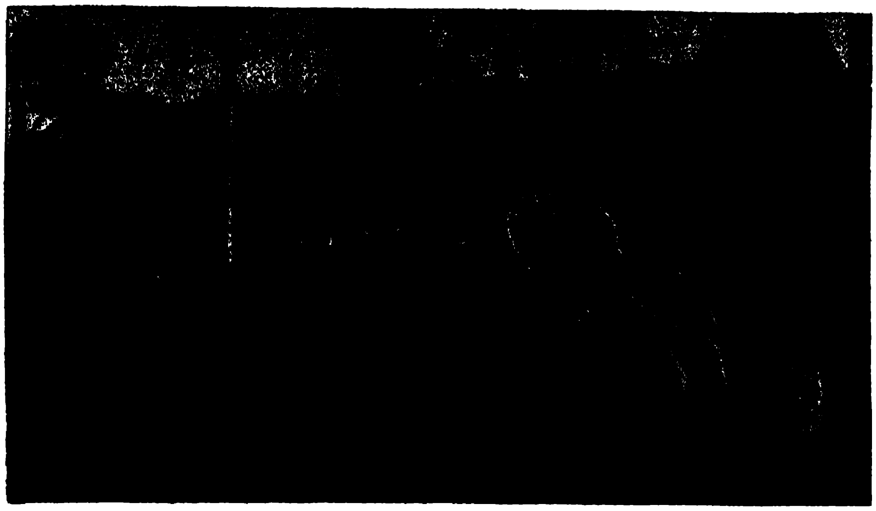


FIG. 11 STRIPPING-PLATE MACHINE FITTED UP TO MOLD MOWER WHEELS

obtained locally or imported from the United States. The latter was in some cases the easier policy, but not the most intelligent. A manufacturer who goes into a foreign country with the attitude of a sponge, always soaking up more, is likely to come to grief sooner or later The Harvester company has always proceeded on the theory that its European plants are integral parts of the countries in which they are located, and wherever possible the policy of favoring the local producer is followed, other things being equal. Good will is thus created, and when necessary the hearty co-operation of governmental authorities can be secured. This is a more important matter in Europe than it is in the United States.

Furnishing the different units of the plant once more with power constituted one of the largest single jobs connected with the reconstruction work The foundry machinery, as previously stated, is all motor driven, and the Germans took all the motors--over 2200 horsepower in the whole plant—together with the starting devices, switches, wiring, shafts, pulleys and belts. The 150-horsepower Ingersoll-Rand motor-driven air compressor, used mainly for foundry purposes. also was removed. Both foundries were stripped of everything that had to do with the generation or transmission of power. Four of the seven main transformers also were carted away. New power equipment has been purchased throughout, mostly in France.

The overhead hand cranes in the gray-iron foundry were not disturbed. The charging-floor hoist was put out of action through the removal of the boilers, this unit being a steam-hydraulic elevator of the Ridgeway type. This hoist has been put back in service in an ingenious manner which illustrates the numerous expedients it has been necessary to devise to get the plant again on an operating basis. The delivery of the new boilers being long delayed by traffic congestion and other causes, a heavy-duty chain hoist of the triplex type was secured and belted to a 4-horsepower motor in the manner illustrated in Fig. 5, the elevator platform being suspended directly from the chain-hoist. The general exterior arrangement of this device is shown in Fig. 3. Although this improvised hoist operates slowly, it serves the purpose for the time being, and allows the cupolas to be charged.

FIG 13--HOW THE 3750 NEW FLASKS WHICH WERE REQUIRED WERE MADE

The gray-iron foundry building was not damaged except for the window panes which had to be renewed almost completely. In the whole plant some 3600 panes of glass were replaced. The water-piping had not been disturbed although the 60-cubic meter tank which supplies the plant was allowed to half fill with sludge.

The two cupolas are of the old Colliau type and were built by Byram & Co., Detroit. They are lined at present to an inside diameter of 40 inches and are rated at approximately 10 tons per hour. They present no special features.

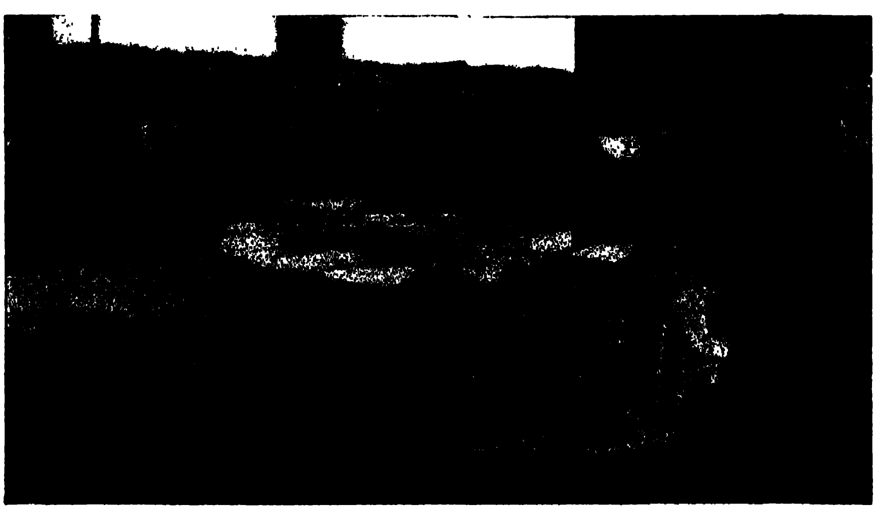


FIG. 12—DETAIL OF IMPROVED MOWER-WHEEL FLASK SHOWING CLAMPS

The arrangements on the charging floor and at the spout are shown respectively in Figs. 4 and 6. The ladle equipment was all taken by the Germans and has had to be replaced. Fig. 6 shows the type of bull ladle now employed. It is cylindrical, with removable ends and a pouring spout on one side fitted on like a boiler saddle. It is said to be always in balance and to hold the heat unusually well.

Under normal conditions ordinary good gray-iron mixtures are melted, as in similar foundries in the United States. Half of the charge consists of good machinery scrap, including the foundry remelt. The pig iron which makes up the other half of the burden usually is mixed in the ratio of 25 per cent French hematite, or low-phosphorus, and 75 per cent French foundry iron. The hematite has approximately the following composition: Silicon, 2.0 per cent; manganese, 1.5 per cent; sulphur, 0.06 per cent; and phosphorus, 0.10 per cent. The foundry iron contains: Silicon, 2.3 per cent; manganese, 0.6 per cent; sulphur, 0.05 per cent; and phosphorus, 1.0 to 2.0 per cent. The transverse strength of the mixture is about 2660 pounds per square inch. The coke, which is used in a ratio roughly of 1 to 9, has the following composition: Volatile matter, 0.75 per cent; moisture, 1.00 per cent; sulphur, 1.1[illegible] per cent; ash, 12.92 per cent; and fixed carbon, by difference, 84.20 per cent. Its heat value runs about 7000 calories per kilogram.

The molding practice is standardized along well known American lines and presents no unusual features to those acquainted with the methods employed in the United States for molding mower frames, mower wheels, etc. These methods have been frequently discussed in THE FOUNDRY. Stripping-plate machines are employed almost exclusively for this work. Fig. 7 shows two mower-frame machines built by Henry E. Pridmore, Inc., Chicago, mounted on platform trucks for return to the foundry from the tool room where they were repaired. These machines, were in the hands of the enemy for over four years. A round stripping-plate machine fitted up for molding mower wheels, with one of the new flasks, is shown in Fig. 11 ready for work again alongside the heap of new sand. This machine sits about where the Germans had their rolling mill and the transformation of the shop back to ordinary foundry conditions is evident. Another view of the new mower-wheel flasks, which are of a sturdy improved type is shown in Fig. 12. Note particularly the strong, improved flask-clamp shown in this illustration. It is made of cast iron specially to fit the flasks and is provided with a coarse quick acting screw clamp which insures a tight hold. The method of making the mower-wheel flasks themselves is illustrated in Fig. 13. They are molded in wooden boxes on the floor in the ordinary manner, and as previously stated it was necessary to make about 3750 flasks of this and other types before the foundry could be restored to the condition shown in Fig. 14, ready for operation. This latter illus-

FIG. 15—AN IMPROVISED BUGGY USED FOR HANDLING FLASKS

FIG. 14—A MOWER-WHEEL FLOOR ONCE MORE READY FOR BUSINESS AFTER CLEARING OUT DEBRIS LEFT BY THE GERMANS

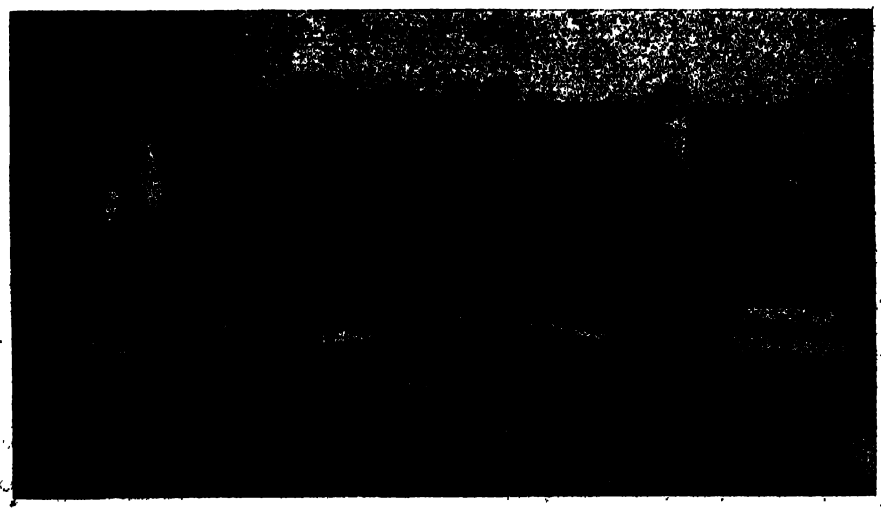


FIG. 16—A GIRLS' CORE ROOM HAS BEEN FITTED UP FOR SMALL CORES

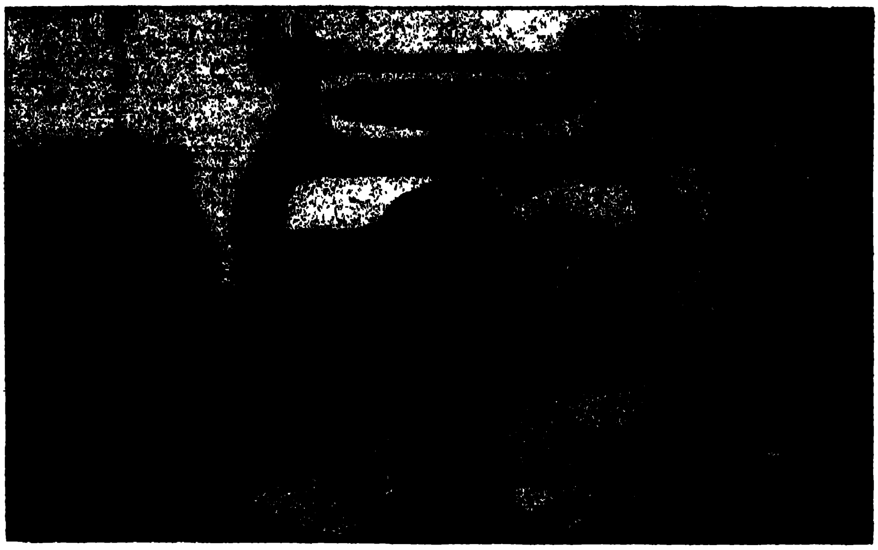


FIG. 17—SAND-MIXING MACHINE OF FRENCH CONSTRUCTION

tration shows clearly the general arrangement of the mower-wheel floors.

Another one of the expedients adopted to quickly make good the havoc wrought by the invaders is illustrated in Fig. 15, which shows how paint-shop buggies were impressed into service in the foundry to handle flasks and other materials.

Tool-Room Difficulties

Since all the flask and pattern equipment had to be renewed and refitted to the machines, the tool-room and metal pattern shop in the main building was a very important place from the standpoint of the foundry. It was necessary also to send the molding machines into this department for repairs. But the tool room was stripped clean and had to be re-equipped throughout. It was necessary to replace nearly 40 tools from engine lathes down to small grinders. The cost of this new equipment is far in advance of the original investment prior to the war.

Similar conditions were met in the wood pattern shop, where rip saws, cut-off saws, wood shapers and jointers had to be replaced.

A new girls' core room has been fitted up with modern benches, core boxes, etc. It is shown in Fig. 16. One of the few pieces of French equipment, aside from motors, shafting, etc., installed in the gray-iron foundry is shown in Fig. 17, where it remained undisturbed. It is a facing and core sand mixer of the rotary paddle type, fitted with large spherical cast-iron cages for grinding up the sand.

The general features of the malleable castings foundry have already been described. The Germans seemed to be so busy in other departments, that, relatively speaking, they left it alone. It was used for a time as a stable and has had to be completely renovated, and much of the flask equipment, pots, etc., renewed. Round cornered annealing pots are employed. They are made of white iron and are cast in large wooden flasks on the floor, as shown in Fig. 18, which illustrates one of the pots coming out of the sand. A whirling skim-gate is employed to insure clean metal.

The fate of the raw material and stock in process of manufacture at the outbreak of the war has already been sketched. All of it disappeared during the four years occupation. Therefore in addition to rebuilding and replacing the equipment, a complete new stock of sand, coke, pig iron, facings, and other foundry supplies has had to be secured. The molding sand comes from nearby and is of exceedingly good quality. French sand in fact is famous throughout the world and the finer grades are imported extensively into the United States for certain classes of work. For other materials, many new sources have had to be developed. For instance it has been necessary to go far afield for coal and coke, due to the reduction of the output of the Bassin du Nord mines near at hand from 4,800,000 tons in 1913 to 900,000 tons in 1919. Similar conditions apply to pig iron and other essential materials.

A new personnel also has had to be assembled in order to operate both the gray-iron and malleable foundries. Some of the old employes are still at hand; all that can be located are being taken back. Many unfortunately are dead and others have been so scattered by the war that it is impossible to discover them. So there are many new faces in the casting shops, and throughout the plant, now that the Croix-Wasquehal foundries are again ready for work.

FIG. 18—SHAKING MALLEABLE ANNEALING POTS OUT OF THE SAND

Publishes Periodical on Asbestos Products

Asbestos is the title of a new monthly publication which is being issued in the interest of the asbestos and magnesia industries for the purpose of bringing about better understanding among miners, manufacturers, jobbers and consumers. The new magazine, of which the sixth monthly issue now is off the press, is published from 721 Bulletin building, Philadelphia. The current issue contains several interesting articles on asbestos and magnesia products together with some market statistics and developments.

The Dodge Steel Co., of which Kern Dodge, Morris building, Philadelphia, is president, just has completed a modern steel foundry at Tacony, Philadelphia, equipped with an electric furnace of the Greaves-Etchells type.

Electrical Melting of Alloys—I

Fundamental Reasons Underlying the Evolution of Electric Furnaces for Melting Nonferrous Metals Are Analyzed — Theory Blazed the Trail Which Practice Followed in Design

BY H. W. GILLETT

An Engineer's Study of Brass Furnaces

STARTING with this issue THE FOUNDRY presents a series of articles covering the entire subject of electric furnace practice as applied to nonferrous metals. The series was prepared especially for this magazine by H. W. Gillett, chief alloy chemist of the United States bureau of mines, who is undoubtedly one of the best informed practical authorities in the world on this subject. The facts upon which the articles are based were gathered by the author during seven years connection with the bureau. However, the deductions and conclusions drawn and all opinions expressed are presented according to the individual viewpoint of the writer and in no sense are to be considered the official judgment of the bureau. Electric furnaces for melting nonferrous metals are a comparatively recent evolution, but careful study and research have brought them to a high state of perfection within a few years. Mr. Gillett analyzes the entire field of electric brass melting and gives the reader the benefit of his engineering judgment relative to the adaptability of electric units under different operating conditions. He takes up each type and points its merits and limitations. He comments upon the points of design in terms which are readily understood by the practical foundryman whose knowledge of electrical science is limited. Costs, both of installation and operation, are studied in detail and the method of arriving at the best economy is presented. Mr. Gillett suggests in a simple direct way numerous practical points on setting up, and operating the different electrical units. He presents a forecast of the future development of electrical melting furnaces, outlining improvements which are needed in the present types. This series will run continuously through succeeding issues until completed.

FOUR years ago there were no electric furnaces in commercial use on brass melting, although several types extant were almost past the experimental stage and ready for industrial use. There are now in commercial operation or contracted for, something like 250 electric furnaces. The phenomenal growth of electric brass melting is made even more striking when compared with that of electric steel furnaces. The electric steel furnace in this country was started in 1906. In 1911 there were only four. In 1917 there were 155, and there are now 323 in the United States and about 1025 throughout the world. It is true that electric steel furnaces normally are considerably larger than electric brass furnaces, but the same is true of fuel-fired furnaces for the respective purposes. In fact, the average electric brass furnace has a greater capacity than the average fuel-fired brass furnace, while the average electric steel furnace has a smaller capacity than the average fuel-fired steel furnace. It is doubtful if tonnage steel ever will be made generally in the electric furnace, while tonnage brass, if it can be so termed, seems certain to be.

Since the electric steel furnace can refine cheap, low grade scrap to high quality metal, while the electric brass furnace merely melts and cannot refine, it would seem off-hand that the steel furnace had the advantage. What, then, is the reason for the amazing growth of electric brass melting, since its inception four years ago?

There is one perfectly good and sufficient reason—it costs less to melt brass by electricity than by fuel. Like all general statements, this is true in the great majority of cases, and it is false in others. In those where it is true, it may cost a little less, or it may cost a great deal less. Relative economy depends upon different factors, just as under varying conditions a Packard, a Ford, or a donkey each may be the cheapest method of transportation. The different electric furnaces in commercial use, and the conditions under which different types are the most economical, or under which it is best to utilize the old stand-by, the pit fire, will be discussed in later articles. The reasons why electric furnaces as a class, properly chosen for the work in hand, reduce melting costs in the general run of foundry and rolling-mill conditions will be considered here. When the theory and practice both are correct, they both agree sooner or later. One often lags behind the other, and, more often than not, it is the scientist—theorist, if you will—who is hard put to it to keep up with his practical brother. The scientist must evolve the correct theory to account for the practical success of someone who didn't know that a previous theory indicated that a certain scheme would not work, but went ahead and made it work. The electric brass furnace did not happen in this way. It was recognized 15 years ago that fundamental laws of physics and of chemistry indicated that an electric furnace, one that could be tightly closed to keep the air out and the zinc in, should prove the ideal brass melting medium. Back in 1905, Roeber*, since dead, a shrewd electrochemist and a good American citizen though of German descent, pointed out that the electric furnace offered

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Published by permission of the director of the bureau of mines. This series of articles was prepared at the request of the editor of THE FOUNDRY. More complete data will be presented in a bulletin of the bureau of mines soon to be published.

*Roeber, E. F., editorial, "Manufacture of Brass in the Electric Furnace," Electrochem. & Metallurg. Ind., Vol. 3, 1905, p. 4.

larger melting units with the attending decrease in labor cost, the elimination of crucible cost, a high grade product, and the almost complete elimination of the loss of zinc. He predicted the replacement of the old crucible brass furnace by the electric furnace inside of 10 years. Had suitable electric furnaces been ready to translate theory into practice, his prediction might have been fulfilled in the period stated, but they were not. If this replacement had been brought about before the war, the saving in metal losses, crucible and labor costs during the years 1917 and 1918, according to the writer's computations, would have reduced war expenses by not less than $20,000,000. The growth of electric brass melting did not come soon enough to make this saving. However, it is making considerable savings now, and will continue to do so at an increasing rate. Practice is beginning to catch up with theory.

Metal losses in fuel-fired furnaces occur by loss of zinc and lead through volatilization, by oxidation and slagging-off of less volatile metals; and mechanically, by spilling into ashes and by fine particles being blown out or drawn up the stack. These losses occur because the products of fuel combustion must get out of the furnace. The draft, or the flow of gases, carries with it much zinc and lead. Excess air usually has to be admitted and that causes oxidation. Sulphur from the fuel may be present in the products of combustion and may be taken up by the metal Neither the volatilization losses, the oxidation, nor the absorption of sulphur are constant, so the product varies in composition and in quality.

If we could close a furnace tightly and generate the heat inside it, we could retain the volatile metals and prevent the constant influx of the "sea of air" in which we live. This also would do away with the passage of products of combustion over the metal. Theoretically, all this could be done in the electric furnace, with the result that metal losses should be nearly eliminated and the quality of the product should correspond with that of the material charged, without detriment by oxygen or sulphur. This would produce metal of crucible quality without the use of crucibles, and that in furnaces of respectable size. The need for quality is the main reason for the use of crucibles and their fragility is the main reason for the small melting units in crucible practice.

It then should be possible to eliminate crucible cost and vastly reduce labor cost by larger scale operations. These costs also are eliminated and reduced by the open-flame oil furnace, but that does not help on yellow brass because the volume of products of combustion sweeps the zinc out. Even on red brass, it is a constant struggle to maintain quality in the open-flame furnace because of the danger of oxidation. Obviously it should require less skill to produce satisfactory metal from an electric than from an open-flame furnace. Good metallurgical results should be obtained more readily, due to the better control of temperature in the electric furnace and due to thorough mixing, and hence uniformity, of the charge. Again, electric heat is clean heat. It is generated within the furnace, and there is no out-rush of heat comparable to that of the gases of fuel combustion. Hence, the vicinity of an electric furnace should be cooler and should make for the comfort and efficiency of the workers.

Since the zinc is retained in the furnace, the danger of *brass shakes* should be reduced. Since pulling pots full of metal from pit fires is dispensed with, many bad burns should be prevented. Electric furnaces therefore should tend to create healthy, efficient and contented, furnace tenders. Moreover, the requirements as to muscular physique should not be as high as for tending pit fires, and the operation of the furnace to produce good metallurgical results, should be more nearly fool-proof than with pit fires, especially the open-flame furnaces. Muscle and experience being less necessary, and workers with brains being more likely to be attracted to the furnace tender's occupation on a relatively clean, cool furnace, the superintendent should be able to choose his furnace tenders from a larger number of applicants when the electric furnaces are used. These advantages all have value, and if they can be obtained cheaply enough in an electric furnace that is reliable enough to stand up to its work day after day and month after month, the wide-awake brass melter desires to obtain them.

It was long after the theory was clear before electric furnace designers had suitable, reliable furnaces ready for operation on brass. They had to leave the previously worked out types of electric steel furnaces and strike out in other, and in some cases, unblazed trails. When they did produce suitable furnaces, they were necessarily expensive to build. Where fuel-fired furnaces are priced in hun-

H. W. Gillett—The Man

IT HAS been said that to know a man you must be familiar with his avocations as well as his vocation, and that no true estimate of his worth may be formed when only his business or industrial pursuit is known The author of this series was asked for some details regarding his career and a photograph to accompany a short biographical sketch in this issue. His reply which is quoted verbatim offers a glimpse of the writer's personality.

. . . . . . I will endeavor to make the articles popular, and will write them from the brass furnace rather than the electric brass furnace point of view.

As to the photographs, I haven't had a real one taken for many years Anyhow, I would prefer the use of the enclosed if it will reproduce.

The "career" is as follows: Specialized on electric furnaces in graduate work at Cornell; general chemical work in the laboratories of Thomas A Edison and A. D. Little; started the research department of the Aluminum Castings Co., thereby gaining some idea of brass, bronze, and aluminum; for the past seven years have been on bureau of mines work with nonferrous alloys, the main problem being electric brass melting; and, during the war, various war problems of the bureau dealing with electric furnaces.

I expect to be an expert in three fields before I die:

1. *Electric brass furnaces.*
2. *Repairing toys as fast as three youngsters can smash them.*
3. *Extraction of all varieties of fish—bullheads to brook trout—from their lairs*

and am dividing my time among apprenticeships in these three fields.

I am one of the numerous vice presidents of the American Electrochemical society, and guess that is all

Please do not refer to me as "Dr." Gillett. I possess and detest the title, as it has too much of a Tuetonic flavor.

Sincerely,

H. W. GILLETT.

dreds of dollars, electric furnaces are priced in thousands.

However, if an American manufacturer can be shown that he will make an ultimate saving, he does not hesitate to make an initial investment. He has to be shown a little more fully that a large investment will save money in the end, than if the original investment is small, but when he is convinced he invests freely. Therefore, high first cost is only an apparent obstacle

Power vs. Fuel Cost

A British thermal unit from electric power costs much more than a British thermal unit as fuel.. A kilowatt hour, the unit on which most electric energy for electric furnace use is bought, is equivalent to 3412 British thermal units. A pound of Connellsville coke averages 12,500 British thermal units, equivalent to 3.7 kilowatt hours. At 1 1-3 cents per kilowatt hour, about the average cost for brass furnace power, it costs 5 cents for the amount of electric energy contained (in its thermal equivalent) in 1 pound of coke

If coke furnaces were as efficient as electric furnaces, this would mean that power at 1 1-3 cents per kilowatt hour and coke at $112 per ton would be equivalent in heating power per unit cost. However, if a coke furnace utilizes 6½ per cent of the theoretical amount of heat in the coke, it is well operated, while, even on eight to 10-hour operation, several electric furnaces will utilize 50 per cent of the heat supplied as electric power, and one or two furnaces, on 24 hour operation, will utilize as high as 80 per cent.

Considering the greater thermal efficiency of the electric furnace, the cost of heat at 1 1-3 cents per kilowatt hour is equivalent to coke at $14.50 a ton in an electric furnace operating at 50 per cent efficiency; and at $9 per ton, in one operating at 80 per cent. Comparing these figures with actual prices for coke, it is easy to see that, while electric energy is still a more expensive means of heating than fuel, yet the margin between cost of power and cost of fuel is not so great. The other savings, in metal loss, crucible cost, or in labor, readily may swing the balance in favor of electric melting.

From the viewpoint of fuel conservation, it is worth noting that, with a moderately efficient electric furnace, one can burn a certain number of British thermal units as bituminous coal under the boiler of a steam-generated, electric power plant, turn it into electricity, transmit the electricity to the foundry, turn it into heat in the electric furnace, and then melt more brass with that heat than he can with the same number of British thermal units as coke, oil or anthracite, used directly in a fuel-fired brass furnace. Where it is available, water power can be used to generate the electric power. Moreover, prices of coal, coke, and oil, unless a long-time contract can be secured, may vary considerably from month to month and lately a general trend upward is noted. A rise in cost of fuel may take place after a price has been quoted for castings and thus cut into the profits. Electric central station companies are public utilities, and their rates are regulated. Therefore, melting costs may be predicted with accuracy for longer periods than when fuel is used

The trend of electric power prices has been steadily downward, owing to the steady improvements in power plant operation. Power prices are now stationary or slightly rising, due to cost of coal, but nowhere in proportion to the cost of coal Power prices may be expected to remain stable and reasonable, with an ultimate reduction when the utilization of water power and the tying in of isolated power plants into larger net works are carried further, as they inevitably must be in the future.

Whatever its source, electric power comes to the foundry over wires and through a meter and transformer, which is a clean and compact way to receive fuel compared with the tracks and oil tanks or coke bins and ash piles of the coke or oil-using foundry. The labor of unloading and carting coke and ash, as well as the need to treat the ash for its content of spilled metal, the pumps and piping for oil, all are obviated.

It must be conceded that the electric brass furnace has many advantages and few disadvantages theoretically. The question is, how does it work out in practice?

The increasing use of electric brass furnaces shows that many, if not nearly all, of the theoretical advantages are present in practice. Not every type of furnace has them all to a complete degree. Most types have most of them in fair degree. Some excell on one point, some on another, so that to obtain all the theoretical advantages, or the maximum possible utility, the furnace must be chosen for the particular work in hand.

Assuming that a reasonably intelligent choice has been made and the particular electric furnace chosen has not been assigned work for which it is not fitted, we find that the following advantages have been found in commercial practice.

Metal losses have been greatly reduced. Plant after plant is regularly melting not only red, but yellow brass as well with less than 1 per cent net metal loss and doing it on charges that would give truly excessive losses in fuel-fired furnaces. In addition to avoiding all working over of ash for contained metal, the electric furnaces produce less slag and dross, and more metal in the ladle. Where a crucible or an open-flame furnace might give 94 per cent ready to pour, 4 per cent in slag, dross and ashes, requiring recovery, and 2 per cent net loss, electric furnaces are producing 98½ per cent ready to pour, ½ per cent to be recovered from slag and 1 per cent net loss. Not only is there 4½ per cent more metal ready to pour without another melt, but 3½ per cent remains to recover, and to lose value, due to its change in composition and adhering impurities, and 1 per cent net or more is saved.

Crucibles have, of course, been eliminated, save where they are used as ladles.

Labor costs have decreased materially where enough electric furnaces are in use to permit this, although during the period in which a plant is getting acquainted with its first furnace, it generally just about breaks even.

Human Conservation

Working conditions are truly improved. The only brass rolling mill which so far has gone completely over to electric melting states that since the change it has not had a single case of *brass shakes,* and the serious burns are greatly reduced. As to coolness and convenience, all that is necessary is to watch a few furnaces in operation —an item of cost most superintendents will be glad to accept. When furnace tenders on fuel-fired furnaces quit work in summer, and the furnaces had to be shut down, electric furnaces in the same plant kept on operating, and the tenders of the fuel-fired furnaces desired to be transferred to the electrics.

Experience has proved that a furnace tender does not need to be an electrical engineer to make his furnace operate satisfactorily, even though it may appear complicated at first sight. Various different types of electric brass furnaces have been operated satisfactorily by negro

crews. This does not mean that brains and their use in controlling the operation of electric furnaces, are not desirable. They are, and since the first cost of an electric furnace is high, it pays to secure brains to plan the work and to keep them going at a high rate of production. However, the actual furnace operator needs only a decent degree of common sense and intelligent supervision. Many foundrymen thought it would be necessary to use men of master-mechanic grade for furnace tenders, but this has not been found essential. Indeed, it is easier to train a green man to handle an electric installation to get good results than to handle any fuel-fired furnace.

Quality Paramount

As to the quality of the product, plant after plant making sand castings reports that the metal is no better and no worse than good crucible metal, though possibly of a little more uniform quality. The writer knows of only one plant where the quality was not considered as good as that from crucibles, and that was a case where a new type of furnace was being tried on which various difficulties with the furnace itself were encountered. Few electric furnaces, of well-seasoned commercial types, have been thrown out, and these few failures usually have been due to the choice of the wrong type for the work to be done.

Some furnacemakers claim slightly improved physical properties for electric brass over other brass, but no one seems to have cut down the thickness of his patterns in order to utilize the extra strength claimed. Proof should be available later on the physical properties of the best obtainable electric brass against the best obtainable crucible brass. Until this is worked out by long tests in a number of plants, it seems like painting the lily to claim a quality superior to the best crucible product. If it is as good as the crucible it is good enough for most any one.

At any rate, the time has passed when even the most fervid electric furnace designer or salesman is likely to spring a line of talk—as one furnacemaker did on the writer in the early days—to the effect that the "electric vibrations in the furnace cause the molecules of brass to rearrange themselves in a different order so that electric brass is stronger and denser than other brass."

Such ideas are pure "bull." The electric furnace has no occult power. It does not perform metallurgical miracles. Neither does it transmute oil, molding sand or second-hand chewing tobacco into good metal. It is a means of producing heat. If one could find a brick that would hold enough heat, heat it up, drop it, and a charge of brass, into a crucible, cover up the crucible and let the heat in the brick melt the metal, he would melt the metal much as the electric furnace does, and with just as much "mysterious improvement" in the quality.

In rolling mill practice there is probably a real improvement in the product, not in the sense that no brass as good has been made in crucibles, but in uniformity of product. The types of furnaces best adapted to rolling-mill use automatically mix and stir the metal so that all the castings from a given heat are uniform. Moreover, the decrease in zinc losses due to electric melting makes for less variation between heats, and melting in larger quantities also tends to smooth out variations due to variations in the composition of scrap fed back. Therefore, rolling mills can work to closer specifications and can make a more uniform product with the electric furnace.

As to over-all melting costs, the best proof is that hard-headed managers and superintendents are increasing their electric furnace capacity. No one can say off-hand that electric melting will save $5 a ton or $10 a ton, and have his statement necessarily true for any particular foundry. One can make an approximation as to possible savings in the industry as a whole and hit the right order of magnitude at least; but as long as different plants have different conditions, whether any electric furnace will cut melting costs, and if so, what furnace will cut them deepest, is a question only to be answered in the light of specific conditions. Knowing his own conditions, and knowing the general performance of the various types of furnaces, on which data will be presented in later articles of the series, the manager can first cast out the types that will not meet his conditions. He then can get down to brass tacks in the consideration of what the remaining furnaces have done under commercial conditions similar to his own. From this basis he will be able to make a definite decision either to install no electric furnace, to adopt some particular electric furnace, or to test out single furnaces of two or three types or makes under his own conditions, in order to get the information he needs upon which to base his judgment.

Speaking generally, it is proved commercially that electric brass furnaces, properly chosen, and properly operated, are money-savers in a great variety of plants. It is reasonable to suppose that they will prove so in many more plants.

Foundry is Merged

The Taylor & Boggis Foundry Co., one of the leading castings manufacturers in the Cleveland district, has been absorbed in the merging of five large companies at Cleveland into the Consolidated Iron-Steel Mfg. Co. The new company, which was incorporated last fall, has a capital and surplus in excess of $3,000,000. The companies involved in the consolidation are: Taylor & Boggis Foundry Co.; the Republic Structural Iron Works Co.; the Columbian Hardware Co. the Ideal Hanger Co. and the Duplex Hanger Co. The new owner will take over the various plants immediately, and it is understood the various production programs of the plants will be enlarged. Officers of the new company are: President, I. T. Kahn; vice president, H. F. Seymour; secretary, J. Lehman, and treasurer, Adolph Tuteur. These men with Corliss Sullivan, Joseph Hostetler, Richard Cobb and A. V. Cannon, compose the board of directors.

Will Build Plants

The New Jersey Zinc Co., one of the oldest and largest zinc companies in America, was organized in 1848. Its ore properties are located in various parts of the country, and include the Franklin, N. J., mine from which a high quality ore is secured. The company now is operating zinc oxide, lithophone and slab zinc plants in Pennsylvania, Virginia, Illinois, Wisconsin, Kansas and Oklahoma, and contemplates the erection of additional plants at strategic geographical points. Construction work will be commenced immediately on plants in Colorado and Pennsylvania.

The G. & R. Foundry & Machinery Co., Terre Haute, has purchased the plant of the Crawford & McCrimmon Co., Brazil, Ind. This gives the parent company additional gray iron casting capacity which is fitted to handle work up to 10 tons, and also affords additional brass and bronze casting facilities. The officers of the G. & R. Foundry & Machinery Co. are Sam T. Greenberg, president; Frank H. Reynolds, vice president; Charles Haze, secretary, and H. Stevenson, treasurer.

Methods for Molding Smoke Stacks

The Rigging Provided for Green Sand Cores Prevents Them from Bending and Permits the Production of Much Thinner Castings Than Is Possible When Using Dry Sand Cores

BY H. N. TUTTLE

SMOKE stacks such as are commonly used on steam tractors, portable sawmills, etc., are usually made of cast iron, of round section, the lower end curved and flanged to fit the boiler, while the upper end generally has some style of bead on the outside with a grooved seat and locking lugs for holding a spark arrester screen. Fig. 1 shows a typical stack of this kind. The ordinary way of molding this casting would be from a split pattern, with a dry sand core, made in a half box and pasted, but in foundries where a great many of these stacks are made, some method of making the core in green sand has generally been developed. This is not only to eliminate the cost of cores and fitting the same, but also to relieve the usually congested condition of the core room. The rigging employed in some of these methods is shown in the accompanying illustrations. Fig. 2 shows a cross section of the stack illustrated in Fig. 1, where the green sand core is *struck up* by turning as in a lathe. The arbor upon which the green sand is *struck* is made of cast iron staves, bolted onto three cast iron heads. An end view of one of these staves is shown at *A*. It is made in the form of two ribs or "fins" about ¾-inch high by ¼-inch thick, with slotted perforations between the ribs, to facilitate the escape of gas into the center of the arbor. The cast iron heads to which the staves are bolted are shown at *B*, *C* and *D*. The gas pipe center *E* serves as a spindle upon which the heads are strung for convenience in building, as well as for strengthening the arbor. The ring, *H*, with fins on the outside similar to the arbor is slipped over the small end of the arbor, and wedged in place. This is to permit the *striking up* of an enlarged diameter at the base of the stack. Of course, if the arbor were made in one piece, of this shape, it would be impossible to remove it from the casting. A dry sand ring core, *G*, makes the seat for the spark-arrester screen, with its locking lugs. Another dry sand core, *F*, cores out the undercut where the base of the stack fits the boiler, and also makes the oval shape of the base. In making this green sand core, the arbor is set in a sand bin, the heads *B* and *D* fitting into corresponding seats provided for that purpose. These heads are turned in the machine shop, to make them perfectly cylindrical. The sand is packed over and between the fins of the arbor by hand, the molder turning the arbor as he proceeds with the ramming. After the arbor

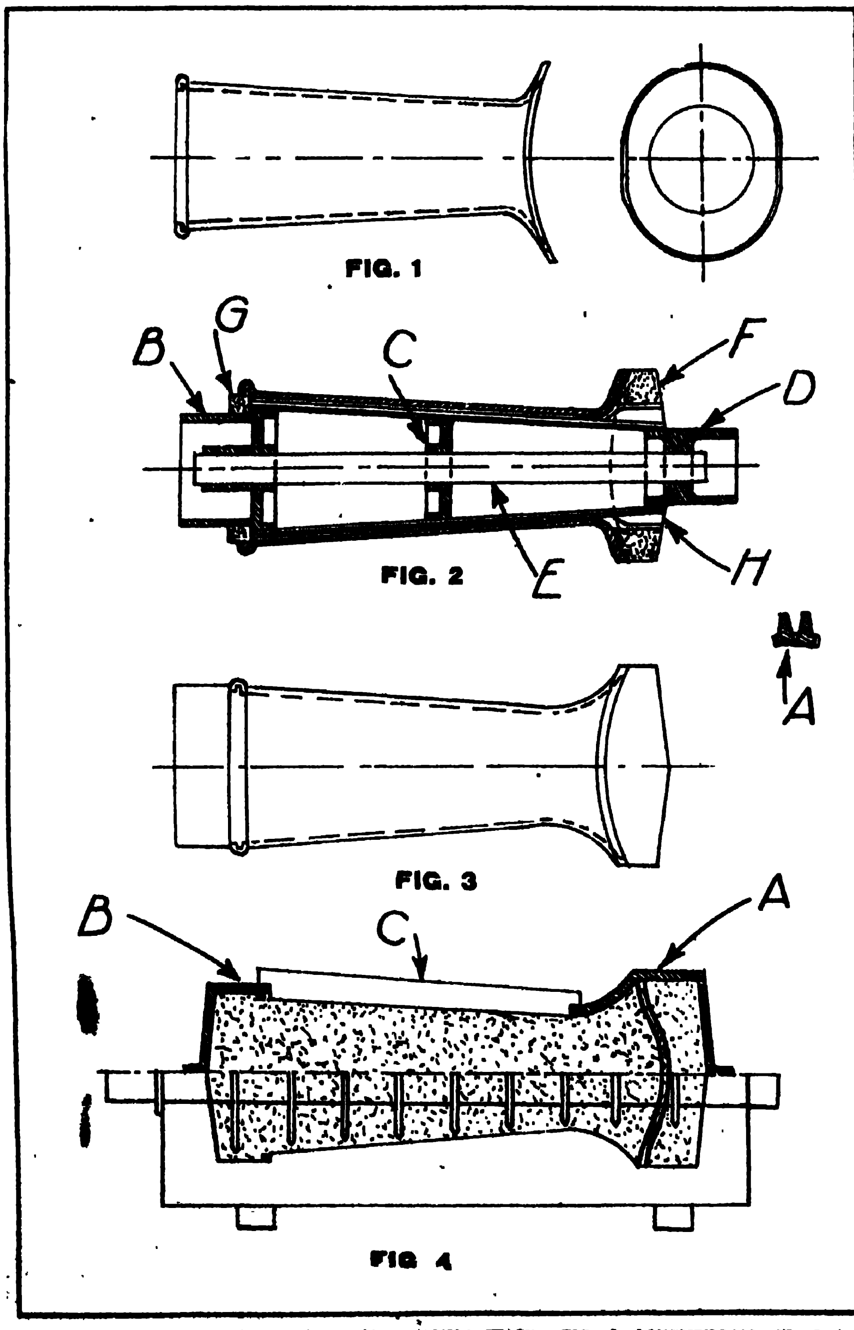


FIG. 1—SIDE AND END VIEW OF TYPICAL SMOKE STACK FIG. 2—LONGITUDINAL SECTION OF CASTING WITH CORE IN PLACE FIG. 3—SLIGHTLY DIFFERENT STYLE OF SMOKE STACK FIG. 4—THIS CORE IS MADE IN A HALF COREBOX, THE TOP OF THE ENDS FORMED IN SHELLS AND THE CENTER TOP SURFACE STRUCK OUT

is completely rammed or packed, the molder sets the "strike" against the correctly located stops, and slowly turns the arbor one revolution This cuts the core to exact size. After setting the dry sand cores, *F* and *G*, the green sand is slicked and faced with plumbago. The green sand core is now ready to be set into the mold. The arbor projects through the ends of the flask, and as the holes in the flask ends, the prints on the pattern, and the arbor heads, have all been made to exactly the same size, it is impossible for the core to shift. Also on account of the stiffness of the arbor, the core cannot raise or buckle in the center. For these reasons it is possible to produce castings with a thinner metal section than with dry sand cores.

Fig. 3 shows a stack similar to Fig. 1, except that the oval base slopes more gradually into the round part of the stack. In this case a much larger dry sand core on the base end would be required, while a correspondingly smaller part of turned green sand core could be used, if made by the method shown in Fig. 2.

Fig. 4 shows another method of making this in green sand, better adapted to this shape of stack. The lower half of the core is made in a half corebox, similar to a corebox to be used for dry sand, with the exception that it has *V*-notches cut in the ends for bearings to support the ends of a cast iron arbor. Fig. 5 shows an end view of this arbor, a half square cast shaft with wing bars cast on, about 5 inches apart. The last two bars on the base end of the arbor are left small enough to permit removal of the arbor from the casting. Special gaggers are used to help support the sand in the enlarged base end of the core. These last two bars might be made to desired size, slipped over the arbor loosely, and held in place by wooden wedges. After the lower half of the core is rammed, loose cast iron shells, *A* and *B*, Fig. 4, are placed on the corebox, being located by dowell pins. These shells are tucked by hand through the open center ends. The center part is then rammed and struck off with the strickle *C*. If the upper end is of such delicate shape that it cannot be made to stand up in green sand, dry sand *ram up* cores may be placed in the corebox before ramming. After the core is made, it is lifted by means of the *V*-ends, which are set in corresponding notches in the ends of the flask.

In case the stack is a short one, the whole upper half of the corebox may be made in the form of a shell, the upper half of the core being rammed through the open ends. Short stacks are often made standing in a vertical position, the center being rammed in green sand and left standing in the drag, while the outside is coped off. Any bead at the top in this case is usually made with a ram up core.

Fig. 6 shows diagrammatically a method of making a green sand core in a whole corebox similar to dry sand coreroom practice. The arbor *A*, similar to the arbor used in Fig. 4, is rammed in one half corebox. This will be the drag half of the core. It is essential that the arbor be located exactly in the corebox, as shown by the previous method. The other half core *B*, is rammed without an arbor. After both halves have been rammed and struck off even with the parting, the two half boxes are swung up to position *C*, then swung back together until *A* is in its original position. *B* is then thrown back, to its original positon, and the core is ready to be lifted out of *A* and into the mold. Fig. 7 shows a plan of the hinges for this complete corebox.

One of the advantages of a green sand core is that it does not settle, as a baked-sand core does. How this feature is sometimes utilized to get a perfectly round core of large dimensions, say three or four feet in diameter, is shown in Fig. 8. *A* is a cast sleeve, about 5 inches smaller than the outside

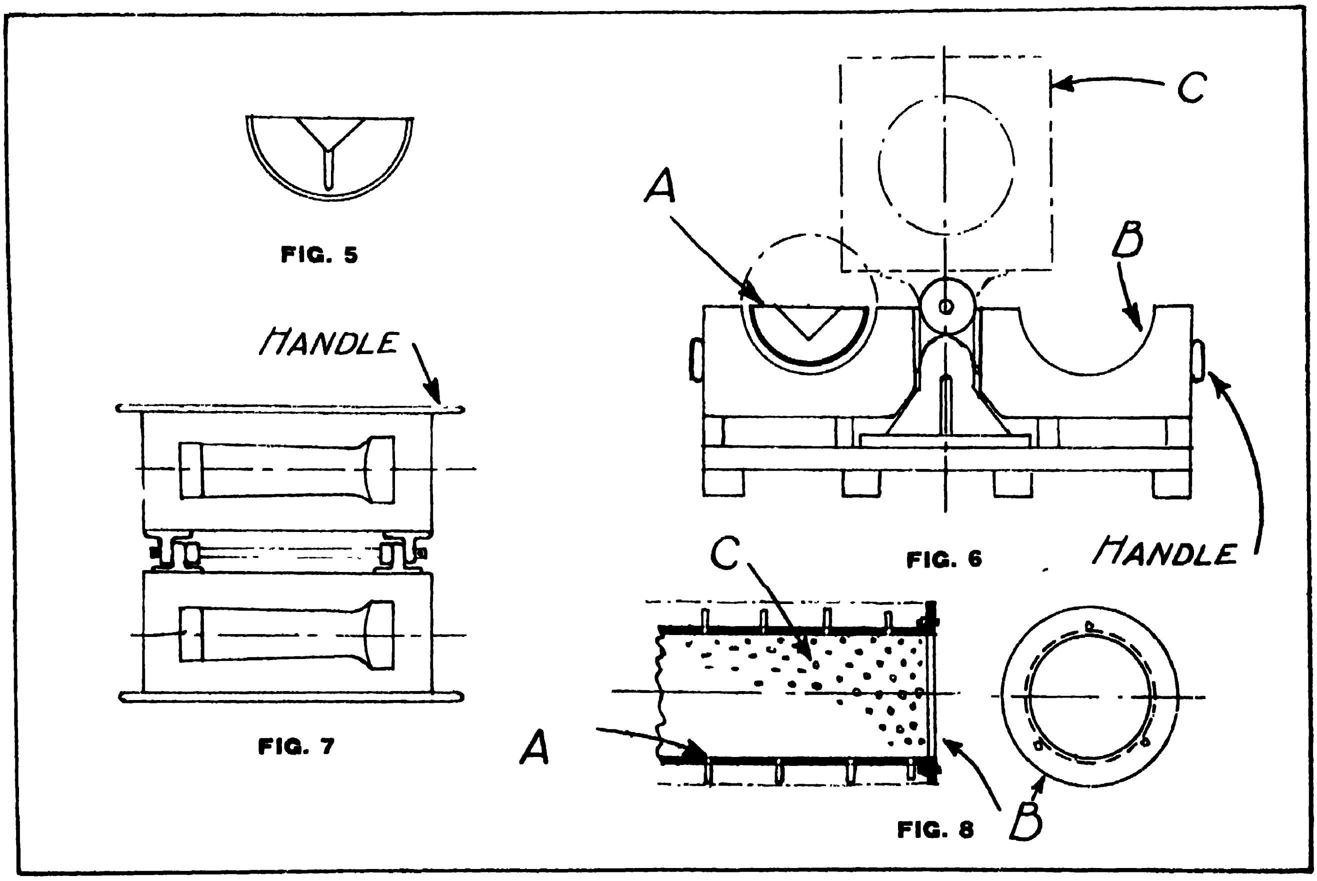


FIG. 5—ONE OF THE ARBOR WINGS FIG. 6—END VIEW OF TWO PART COREBOX FIG. 7—SHOWING DETAIL OF HINGES FIG. 8—SECTION AND END OF A CORE BARREL PROVIDED WITH WOODEN PEGS TO CARRY THE SAND

diameter of the required core. *B* is a flange, turned outside to the exact size of the desired core. *C* shows the half inch holes which are spaced about 3 inches apart over the entire surface of the sleeve. Before ramming the core, wooden pegs are driven into every other hole to help support the sand. The other holes are for vents. A flange *B* is bolted on either end of the sleeve, and the intervening space rammed with green sand. It is then struck on the outside with a straight edge. The arbor may be rolled along a special wood track while the core is being molded, to protect the sand from the floor. Or, a spider may be cast in the flanges, and a large shaft put through the center, which will act as a support. In any kind of green sand core work, good equipment is essential.

Six Propeller Blades Made in One Mold

BY J. L. SENDNER

AT THE Puget Sound navy yard and at some of the Seattle foundries, it has been the custom for some time when making propeller blades and wheels to employ only one mold for an entire order. Several months ago one mold served to cast six 2-ton blades and recently four 5600-pound blades were cast in a similar manner. The mold used for this last job as well as the fourth casting made in it are shown in the accompanying illustration.

The flask is the ordinary cast-iron, built-up type, sides and ends having been cast separately and afterward bolted together. The drag is provided with bars as well as the cope for the reason that the casting is poured in a vertical position. The bars also aid materially in assisting the mold to retain its shape and rigidity while several castings are being made in it.

The blade is molded in a horizontal position but after the mold has been dried, cored and closed it is turned up on end and cast in that position with the hub uppermost. The sand used for facing is a western product similar to Albany sand. When used for the purpose under consideration it is bonded with molasses water. After the mold is finished it is surface-nailed closely in ordinary dry sand practice. It is then placed in the oven and baked thoroughly. The sections are assembled and the mold is poured.

The casting is removed shortly after the mold is poured. The latter is allowed to cool and it is then sprayed with molasses water and patched, if necessary. A thin coating of plumbago wash is then applied and the mold placed in the oven to remain over night. The following day it is taken out, assembled and cast and the same program repeated as has been outlined.

Differs From Common Practice

It is common practice where the blades are made in loam to use the molds more than once but usually the only part saved is the brick work. A new coating of loam has to be swept on, finished and dried for each casting. The method herein described and illustrated does away with the bulky and expensive loam work and is quite economical when compared to the usual dry sand practice of providing an entire new mold for every casting. The largest castings made from the type mold here shown were two 3½-ton, 4-blade solid wheels. The largest number of blades cast off one mold has been six, but the mold as shown in the accompanying illustration could be used, in the writer's opinion, for at least 10 additional castings.

Acquires Plant of Arcade Malleable Iron Co.

The Baldwin Chain & Mfg. Co., Worcester, Mass., has acquired the Arcade Malleable Iron Co., which has been doing business in that city for 70 years. Alonzo G. Davis, president and general manager, who has conducted the business since the death of Paul B. Buckingham, son of George B. Buckingham, a former owner, about two years ago, retires with the change in ownership. The company has reorganized with the same officers as that of the Baldwin Chain & Mfg. Co., George T. Dewey being president and William H. Gates, treasurer. J. Denison Kenyon is general manager.

Williams, White & Co., Moline, Ill., have purchased steel for the erection of a new foundry building, 325 x 150 feet, with a covered material yard. The Clement A. Hardy Co., Chicago, is acting as engineer.

DRY SAND MOLD FOR PROPELLER BLADE AND FOURTH CASTING MADE FROM THIS MOLD—THE CASTING IS MANGANESE BRONZE POURED FROM TWO RUNNERS AND HAS TWO LARGE RISERS FOR FEEDERS

Investigation of Silicon Reviewed

Investigations Forty Years Ago Were Handicapped by a Limited Knowledge of Analytical Methods, but Professor Turner's Work Gave a Clear Indication of the Effects of Silicon on Cast Iron

REMINISCENCES of the pioneer work done 37 years ago in studying the effect of silicon in cast iron was given by Prof. T. Turner, Birmingham university, in an address before the Coventry branch of the Institution of British Foundrymen, recently. The speaker called attention to the fact that all cast iron contains carbon, silicon, sulphur, phosphorus and manganese. He said that manganese is a metal and that sometimes other metals are present in cast iron. Small quantities of chromium and of nickel, or of copper, might be added to cast iron to give a denser structure. However, excluding manganese and other metals, the four elements which are always present in larger or smaller quantities are all specifically lighter than iron. The result is that bulk for bulk cast iron weighs less than pure iron, and the larger the proportion of non-metals present the lighter, or the less dense, would be the cast iron.

Professor Turner said that all foundrymen are familiar with the properties of carbon in various forms such as coke, charcoal, or graphite. Most of them also know the properties of sulphur; at all events they know it as brimstone, a yellow substance which burns readily in the air with a pungent and somewhat disagreeable odor. Phosphorus is generally known because it is used when mixed with various substances for making matches and other products, but foundrymen often wonder what kind of material is silicon, and why so much is said about it. It was pointed out that silicon in its pure form is not unlike graphitic carbon, except that it will not blacken the hands in the same way as plumbago will when rubbed between the fingers. Silicon is one of the most common elements found in nature, but it occurs in combination with oxygen, forming SiO_2, a common form of which is sand. This oxide of silicon is known as silica. It frequently occurs in iron ore, and the result of heating the iron oxide and the sand in the ore together with coke, is that the iron oxide and part of the silica are reduced to metallic iron and silicon. This silicon is dissolved in the iron to form a silicide of iron.

Ambition's Incentive

TURNER is a name which stands out among the pioneer investigators of the metallurgical character of cast iron. Students of cast iron metallurgy appreciate the value of Professor Turner's work to the foundry industry. Therefore, his reminiscences and conclusions given in this article are interesting to all foundrymen. When it is realized how much work has been carried on in the investigation of the effects of silicon in cast iron, it may be asked whether the same amount of investigation carried on to determine the effect of the other well known elements, which are always found in cast-iron, would not bring proportionately as much benefit to the industry. Probably not, because enough has been found out about the effect of these elements to indicate that their general influence is not as pronounced as is that of silicon. However, many facts might be learned from a searching investigation of the effect of the different gases on the properties of cast iron if experiments were carried on as thoroughly as were the experiments with silicon. The fact that accurate determination of gases and detection of the state of their existence in iron is a difficult analytical operation should not hinder, because this obstacle is no greater than those ahead of Professor Turner when he started his investigations. His work is an inspiration to younger metallurgists ambitions for research.

Accurate knowledge of the composition of cast iron dated from about 60 years ago. Professor Turner said that the earlier analyses of cast iron were often entirely erroneous; for instance, large quantities of calcium and of aluminum were sometimes reported being present, and the quantity of sulphur or even of phosphorus was not correctly given. The first step then, was to apply chemistry in such a way that all quantities of these foreign elements could be accurately determined. In England Dr. Percy, who had been called the father of English metallurgy, and who was professor of metallurgy in the Royal School of Mines had most to do with developing the analysis of cast iron.

Immediately after the Crimean war, during which time cast iron cannons were used, it became necessary to obtain a stronger material for guns than had hitherto been employed. Therefore attention was devoted to the improvement of the quality of cast iron, while side by side with these efforts Bessemer was introducing his marvellous mild steel. Professor Turner said that it was not possible then to determine, by analysis, whether a cast iron was good, bad or indifferent for any particular purpose. Because there are many variables which control cast iron and these were not understood. It is not a pure material, it is not a chemical compound, but it is a heterrogeneous mixture of various elements, compounds and solutions, all united together. If one constituent of the metal was varied, and the others also changed to some extent, it was impossible to know whether the results secured were due to one element or to the action of several elements.

Under these circumstances Robert Austen in one of his lectures, when the speaker was a senior student under him, urged that someone should ascertain the influence of silicon on iron and steel. With this object Professor Turner started experiments about 1883. The essential idea of the research was to start with the purest material that could be obtained and add to it the element whose effect on the iron it was desired to observe. The element silicon was selected for the first series of experiments. The metal used as the basis for the experiments was made by melting wrought iron in a crucible packed with the purest charcoal obtainable. The iron was melted and well stirred, then poured out. The resulting iron was white. A great many samples of this kind were made and the best of them were broken and mixed together for a further melt so as to get a uniform quality. The material was, as nearly as possible a pure commercial mate-

rial composed of carbon and iron. At that time the only silicon iron obtainable contained 10 per cent silicon, and it also had more than 1 per cent manganese. Considerable time was spent in trying to get rid of the manganese, but it was found impossible to do this without also removing the silicon. To the first test bar no silicon was added, and the subsequent proportions of silicon in the metal sought were 0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 7.5, and 10 per cent respectively.

Professor Kennedy, who was at that time professor of civil engineering in University College, London, advised as to the shape of the test piece and the method of making mechanical tests. The lecturer exhibited the original pattern from which the bars were cast. These bars were about 1-inch in diameter and 12 inches in the clear. They were designed so that a straight pull would be secured when they were placed in the testing machine. The results of the tests made, are shown in Fig. 1. It shows that the crushing strength increased as the silicon was increased up to slightly less than 1 per cent and then with further silicon additions the crushing strength gradually fell off.

The tensile strength increased and reached its maximum with about 1.8 per cent of silicon, and then, with more silicon added, the metal lost its high tensile properties and gradually became a weak and brittle material. The pure cast iron was hard although it could be cut with a tool. With 2 per cent silicon in the iron the carbon is chiefly in the free state and the iron is gray. This composition corresponds with 35,500 pounds per square inch, which at that time was the record tensile strength for British cast iron. To illustrate how science has progressed in the interval, the speaker said that firms will guarantee their iron to have a tensile strength as high as 38,000 pounds per square inch and will maintain that for a period. It is not uncommon now to have cast iron with a tensile strength up to 47,000 pounds per square inch, and authenticated tests have shown more than 50,000 pounds per square inch. But up to the time when the experiments reported by the speaker were made, there had been no British iron recorded of a strength of 35,500 pounds per square inch.

Carbon exists in iron as free or graphitic carbon and as combined carbon, it was said, and the best way to illustrate the difference between the two forms of carbon is to take a few turnings and rub them on the palm of the hand. If wrought iron, steel or white cast iron turnings are so rubbed, the hand will remain clean. But if the same thing were done with gray cast iron, or any iron containing free graphite, the hand would be polished with the praphite which would come out of the iron, showing the carbon to be in the free condition. The series of experiments which were made showed that one could commence with white iron and by adding silicon could convert the white iron into gray iron which would increase in the intensity of its grayness with the addition of silicon up to a certain point. It thus may be seen that there is a certain proportion of silicon which gives the best results.

The speaker said that Gautier in France, Keep in America, Ledebur in Germany, and a number of other observers took up the idea of strengthening cast iron by the addition of a suitable proportion of silicon. With the limited knowledge of metallurgy held at that time all sorts of mistakes were made. In the first place some tried to mix irons together without a proper knowledge of their composition, or without chemical analyses to guide them. Thus silicon was condemned, not for any fault of its own but because it was used in wrong proportions. Anyone observing the results of experiment would know at once that it is only with a correct percentage of silicon that a suitable result can be obtained.

Other experimenters neglected the fact that the metal would be profoundly influenced by the other constituents, such as sulphur, phosphorus, manganese or even total carbon. It may thus be seen that while silicon was the controlling element in the foundry one must always bear in mind that the proportion of silicon that would be required in a particular mixture would depend upon various circumstances. Professor Turner went on to say that the most important factors are first, the proportion of other elements that were present; and second, the rapidity of cooling, because rapid cooling tends to keep the iron and carbon combined. In other words chilling tends to retain the carbon in solution and to give a white iron, while slow cooling gives the graphite time to separate and make the iron more gray. A small casting will cool more rapidly than a big one, and a casting made in a chill will cool more rapidly than one cast in sand.

Professor Turner went on to say that it must be remembered that the effects of the proportion of silicon which was found in the iron in his experiments would only be the same when all circumstances were the same

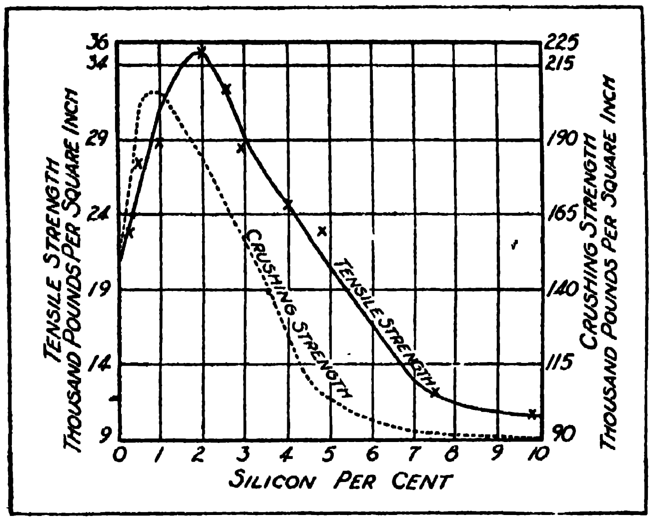


FIG. 1—THE HIGHEST TENSILE STRENGTH WAS OBTAINED WITH 1.8 PER CENT SILICON

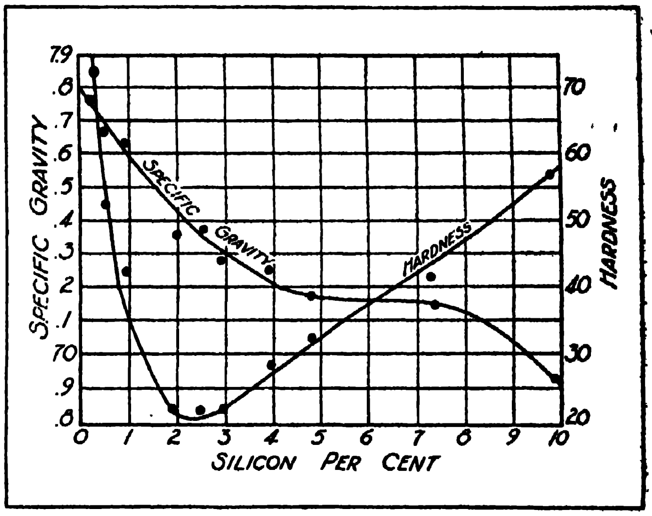


FIG. 2—HARDNESS DECREASED UNTIL THE IRON CONTAINED APPROXIMATELY 2.5 PER CENT SILICON

as they were in his experiments. There were three things to be remembered in reference to those circumstances: First, that a pure cast iron lower in carbon than usual was started with, so that there were no interfering elements present and nothing unusual except the somewhat smaller proportion of carbon; Second, that the casting was 1-inch in diameter and; Third, that his samples were all cast in an ordinary green-sand mold. Under those conditions 1.8 per cent, or thereabouts of silicon, will give the best tensile strength, so far as is known up to the present time.

Note Effects on Hardness

One of the most remarkable things in connection with silicon is its effect upon the hardness of cast iron. At the time of the author's experiments there was no method known of determining hardness in metals, that is, no recognized method, though there had been certain experiments along this line. Therefore, a method of testing hardness was devised by the author. A weighted diamond was used for this purpose and the diagram in Fig. 2 shows the effects on hardness of different proportions of silicon. The first sample contained practically no silicon and was sufficiently hard to scratch glass readily.

With the addition of silicon, the hardness rapidly fell until a material was obtained, which could be easily turned or cut. The iron with about 2.5 per cent silicon gave the maximum softness. The addition of more silicon increased the hardness. The changes showed that in all probability there are two effects proceeding side by side. There was an immediate effect, making the metal soft, and another effect, which came in more pronouncedly afterwards and made the metal hard. The explanation is that the silicon when first added threw the greater part of the carbon into the free form. The purer the residual iron, the softer it became until the point was reached where practically all the combined carbon was changed to graphite and the iron was perfectly soft and could not possibly be made softer. Therefore, all the silicon afterwards added, like any other element that went into solution tended to harden the iron. The formation of a solid solution always leads to a hardening of the iron; the silicon, even from the beginning, was hardening the iron, though this effect was disguised by that resulting from throwing out the carbon. As the carbon was thrown out the effect of the silicon was gradually more and more evident until the curve in the diagram became almost a straight line, indicating that the hardness increased proportionally with the increase of silicon.

Those experiments only dealt with metal containing up to 10 per cent silicon. Experiments since have been conducted by many manufacturers in different parts of the world, with the object of using ferrosilicon made in the electric furnace and containing higher percentages of silicon. Experiments have been made with proportions of silicon as high as 50, 75 and 90 per cent. On examining a melting-point diagram illustrating the properties of iron rich in silicon the important point to notice is that if a start is made with iron melting at 1500 degrees Cent. or thereabouts and silicon is added to it in successively increasing proportions, the melting point of the mixture falls until the relative proportion of silicon to iron, called a eutectic, is reached. This occurs when the proportion of silicon by weight is something under 20 per cent. On adding more silicon a compound, FeSi, which has a higher melting point is formed. With still more silicon addition a second eutectic is formed and then the melting point rises steadily to that of silicon, about 1425 degrees Cent. Therefore if it is desired to obtain a casting rich in silicon, as for instance, in making acid-proof vessels, as much silicon as can be introduced without reaching the eutectic point should be added. When that amount is passed, the melting point rises and a material is obtained which is difficult to handle. However, as long as the silicon is kept somewhere in the neighborhood of 18 per cent it is easy to melt the metal and pour it into a mold.

Influence of Carbon

It has been said that the effect of silicon depends upon the amounts of the other elements present, particularly of carbon. If the total carbon is high, in the neighborhood of 3.5 or 4 per cent, relatively little silicon is required to throw out some of the carbon in the form of graphite. It is known by experience that if the graphite begins to form and the metal is maintained at a high temperature the remainder of the carbon will precipitate out. But if the carbon is low, in the neighborhood of 2.5 or 2.75 per cent, it is necessary to add more silicon to throw the carbon out of solution. Enough silicon must be added to form the lower silicide of iron, and to leave behind only enough free iron to retain the carbon. In other words, the silicon for the purpose of solubility uses up some of the iron, and then begins to throw out the carbon. However, if there is little carbon present, more iron is free to be combined with some other element before the carbon can be thrown out. Therefore, the primary or fundamental effect of silicon is upon the carbon. One result of this is that the more carbon that is thrown out of solution the less the metal contracts because the carbon is light and bulky when in the free state. Hence, in making a casting with white iron, more contraction must be allowed for than when making a gray-iron casting. When the white iron used in the malleable trade is annealed an expansion takes place, and the net result of the extra contraction and the subsequent expansion makes the contraction of malleable iron approximately the same as that of ordinary gray iron.

Contraction Test

There is no better rough test of the character of an iron than to determine its contraction. Such a test was first suggested by the late W. J. Keep, Detroit. The practice is to pour a small quantity of metal into a mold exactly 1 foot long. The ends of the bar are determined by a cast-iron yoke. After the bar has cooled a small wedge is put between the yoke and the bar to measure the amount of contraction. It has been found that the character of the product can be predicted with considerable certainty when its contraction is known.

If phosphorus and silicon are present together the result is gray iron with phosphide eutectic. The main portion of a deep gray iron is siliceous iron or silico-ferrite and the graphite is in big flakes. Such an iron is not of the best grade. To improve the quality it is necessary to distribute the carbon and, as far as possible, to disseminate phosphorus.

The iron which has the best physical properties combined with good machining qualities, having density without undue hardness, a high tensile strength and a capability of wearing well, is one which contains just sufficient silicon to throw out the greater part of the carbon in the free state, but to leave sufficient combined carbon to be just under the eutectoid proportion.

Professor Turner said that the proper use of silicon is the key to the management of foundry irons. This can be done without any increased cost. It is not necessary to buy ferrosilicon, because pig iron can be secured containing enough silicon.

Steel Foundry Starts Operations—I

Sweep Is Moved Vertically on a Screw Spindle and Guided Horizontally by a Cam Groove on the Same Spindle — Drying and Annealing Ovens Have Been Built to Conserve Heat

SOARING prices of raw materials and steadily advancing labor costs make it essential for foundrymen to study more carefully than ever before, ways and means for reducing operating expense. Wages and material costs are items beyond the control of most producers of castings at the present time, and it is only by trimming expense items here and there that many are enabled to keep their production costs within bounds. An excellent example of the value of this attention to small particulars and the infinite number of small details which multiplied make up mounting expense, is furnished by the Vulcan Iron Works, Wilkes-Barre, Pa. This establishment which was described in the June 1 issue of THE FOUNDRY, was built last year. It was designed by Westinghouse, Church, Kerr & Co., New York, in accordance with the ideas of B. L. Weaver, foundry superintendent.

Since the plant has been put into operation, two prime principles of keeping down costs are emphasized. One of these is the insistence of mutual understanding between the engineer designing patterns and the foundryman, and the other is the operation of all the furnaces, ovens and other equipment to do the work at a minimum cost and save expense wherever possible.

B. L. Weaver, the superintendent, emphasizes the need of the engineer to understand and appreciate the foundry problems and the importance of the foundry calling attention of the engineer to changes which could be made in the design of the pattern to make the casting a more practical foundry problem. Two instances will suffice to show how mutual co-operation between the designing engineer and the foundryman developed the best means of making a casting.

Designs Are Changed

An example of this is a runner for a speed ring, shown in Fig. 5. The pattern as received by the foundry was not practical because the vanes were tapered almost to a feather edge and if molded that way they would have cracked. It also was found that the bands at the top and bottom needed a heavier finish than was allowed in the pattern in order to come clean when machined. The feather edges of the vanes were thickened to ½-inch and now the vanes are mechanically ground to a feather edge after the casting has been made and annealed. This grinding extends back from the edge 3 inches. The bands were made slightly heavier to allow more metal for finishing and the castings now are made with little difficulty. Both of these changes increased the cost of finishing, but more than saved this cost in decreased foundry losses.

The value of co-operation again was demonstrated when the pattern for the speed ring for a hydraulic turbine, shown in Fig. 6, gave trouble. The vanes of this ring are hollow, and the sections of the vanes where they join the top and bottom rings are much thinner than the sections of the rings at these points. The vanes in such a casting naturally cool quicker than the rings by reason of this difference in section and the strain caused cracking. This defect was remedied by changing the radii of the vanes where they join the rings and adding more metal. It also was necessary to add metal to the top and bottom speed ring because the core which forms the hollow vane tended to rise or fall slightly and could not be held exactly in position. The increase of metal on the rings took care of the slight variation in the casting due to the core rising or falling. Portions of a mold for a similar casting are shown in Figs. 3 and 4. Fig 3 shows the drag which has

FIG 1—THE MOLD FOR A STEEL DRUM IS SWEPT UP AND DRIED—CORES ARE THEN PLACED IN POSITION IN THE CENTER AND AFTER THE COVER CORES HAVE BEEN SET AND WEIGHED THE MOLD IS READY TO POUR—NOTE THE SPINDLE AND SWEEP TO THE RIGHT WITH THE CAM TO GUIDE THE ARM

FIG. 2—FLASKS ARE BUILT FROM CAST-STEEL SECTIONS BOLTED TOGETHER

FIG. 3—THE DRAGS PORTION OF A SPEED RING MOLD AFTER PRELIMINARY DRYING

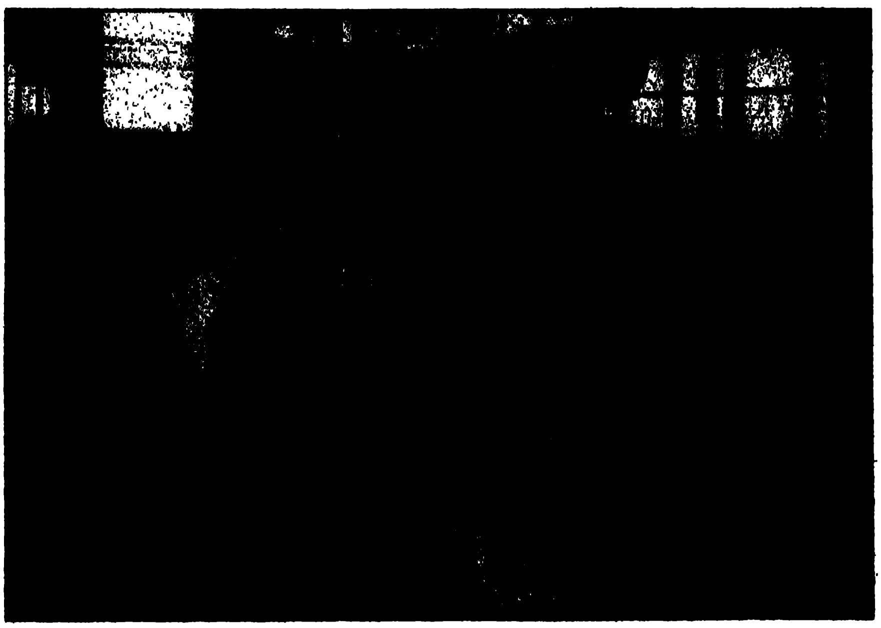


FIG. 4—CHEEK OF A MOLD FOR A SPEED RING—NOTE THE STEEL CHILLS UNDER THE CHAPLETS

been dried in the oven for 12 hours. The cores, shown as the darker portion, are located by *V* shaped notches in the mold as shown at *A*. The gate is a double swirl-type. The metal comes down through a round vertical gate to the drag and then flows through two horizontal runners at right angles to each other. These horizontal runners are set tangent to the ring. The entering metal, therefore, reaches the ring at two points simultaneously and is directed around the circumference. The location of the gate may be noted at *B*. As the cores are set, they are secured to the under side of the drag by wires fastened to gaggers or bolts. In this way the cores are held fast when the drag is turned over on the cheek which is shown in Fig. 4. Coreprints which form the hollows ni the vanes are located in the holes at *C*.

The cheek consists of three flasks of the same thickness as the one shown, and underneath them is a false cope. The flat strips under the chaplets are steel chills which cause the metal between the vanes to set quickly when the mold is poured. After the mold is ready for closing the drag is placed on top of the cheek and the whole bolted together. The entire mold then is rolled over on a plate so that the drag is underneath. The pattern in the cheek section is next withdrawn. The whole mold ready for casting is then placed in the drying oven and baked for 36 hours. It is necessary to give the drag a preliminary drying because of the size of the mold and the large amount of green sand at the center. Some molds, even though as large as this one, which have dried cores in the center, do not require preliminary baking of the drag.

Novel Spindle and Sweep

A mold in which the center is made of dried cores is shown in Fig. 1. This is made in six flasks 12 feet square and 12 inches deep. It is first swept up with the sweep shown in the insert, Fig. 1. This sweep travels on the screw spindle as shown. Each turn of the spindle raises or lowers the sweep arm a certain amount as determined by the screw. It can be used for different molds by changing the forming plate which is bolted on the end of the arm. The grooved ring shown travels vertically along the shaft and serves as a guide or cam, for the rotating sweep arm. The groove which is filled with oil regulates the arm of the spindle by grinding the cam roller which protrudes into it from the arm. The ring is not round but is formed by two semicircles joined by two straight lines. The cam in following this modified circle controls the movement of the sweep so that the resulting mold takes the same form. Thus the

casting which is made is not a true circle in horizontal section, but is in effect two semicylindrical sections joined by two

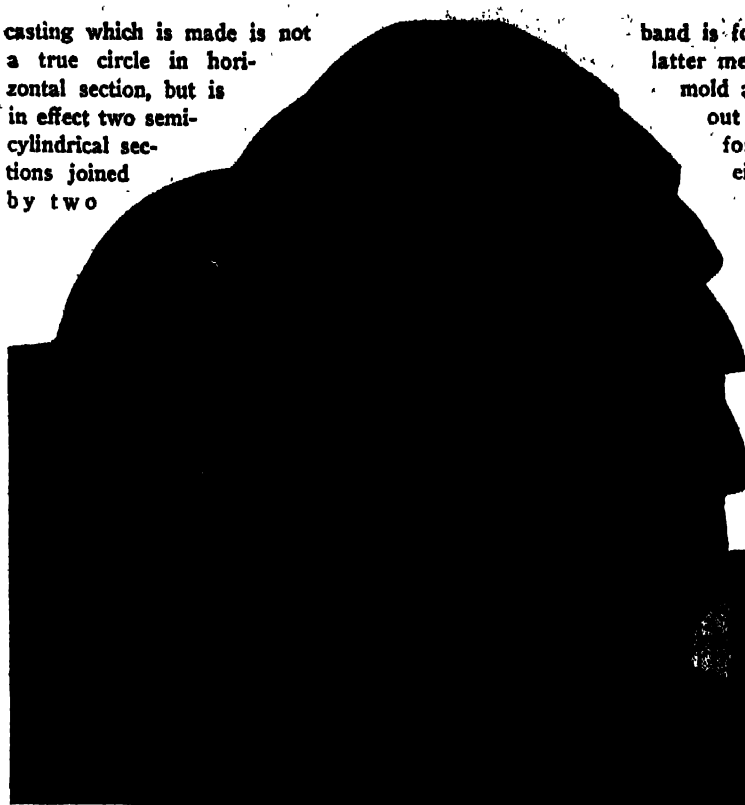


FIG. 5—THIN EDGES ON THE VANES OF THIS CASTING CAUSED CRACKING AS FIRST MADE

planes. The planes between the two cylindrical portions allow the casting to be split in halves without destroying the semicircular section. This is done after the casting is annealed and the two halves are obtained in a more exact circle than if they had been cast separately and been subject to the shrinkage strains the effects of which are more or less neutralized when both halves are made in the same casting. The straight lengths between the semicircular sections allow stock for splitting the pattern and the half cylinders then may be put together to form a cylinder without the use of liners. The large cores shown on top of the mold in Fig. 1 are placed on those already set to form a 3-inch band on the casting. Coring this band is found preferable to sweeping it in the mold as the latter method would require rodding the green sand of the mold and would cause difficulty in cleaning all of the sand out of the ring 3 inches high. A spacing board for gaging the distance between the two cores on either side of it may be seen at *A*, Fig. 1. The core which fits in this space may be seen at *B*. The board is used for getting the correct distance instead of the core. This is because the core is thin and probably would be broken if used for spacing. The mold had been dried 48 hours before work was begun putting in the cores. After all the central cores are in position cover cores will be placed on the mold and weighted down. The mold is then ready for pouring. There is a wide diversity in the size of the castings made by the Vulcan company and many orders are received for only one or, at the most, a few castings off of one pattern.

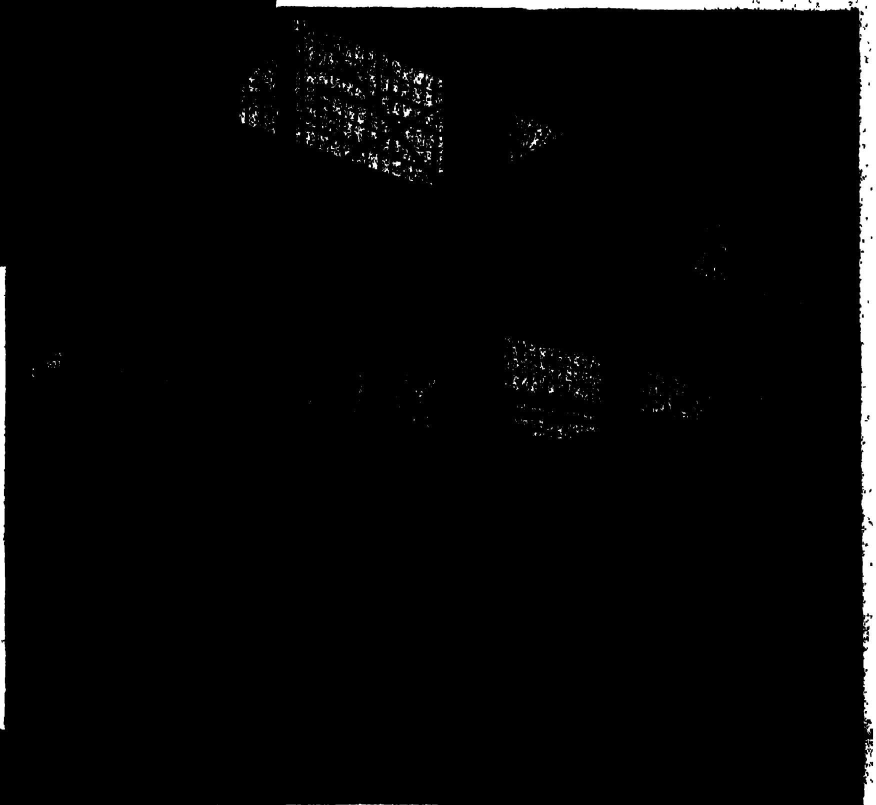


FIG. 7—THE DOUBLE-ENDED CORE OVENS HAVE LARGE CAPACITY

This necessitates a wide variety of flasks which may be combined to make a mold of any desired size or thickness. Flasks are made in sections 12 inches deep as a general rule. Then any number of flasks can be put together on top of each other to form a mold. These flasks are formed from plates bolted together as shown in Fig. 2. It may be noted at *A* how the end and side pieces are joined. Holes for bolting this section to one which may be added above it are shown at *B* and around the top flange. The crosspieces which, like the frame, are made of steel cast in the home foundry, are bolted to the sides and ends through holes as shown at *C*. They also may be bolted to each other as indicated by the long narrow slots in the cross pieces. From the frequency and length of these

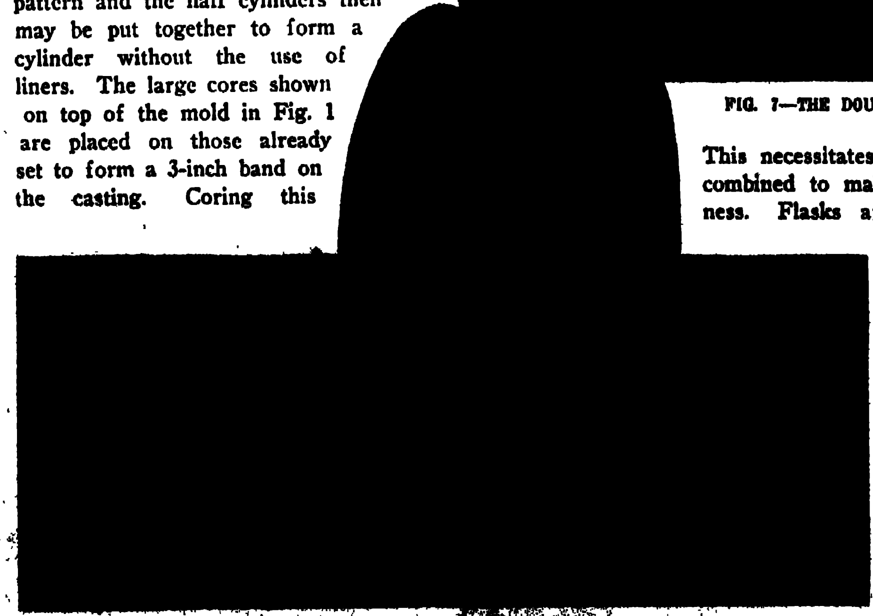


FIG. 6—THE VANES ON THIS SPEED RING ARE HOLLOW AND THE THIN SECTION OF METAL IN THEM CAUSED TROUBLE UNTIL MORE METAL WAS ADDED WHERE THE VANES JOIN THE RINGS

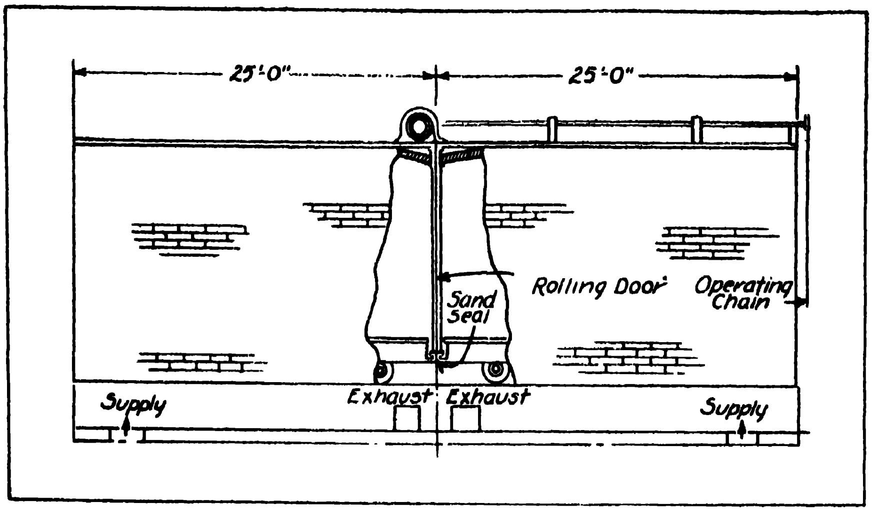


FIG. 8—CORE OVENS ARE BUILT SO THAT WHILE THEY CAN HOLD THE LONGEST MOLDS THEY CAN BE DIVIDED AND ONLY HALF OF THE OVENS USED WHEN ALL IS NOT NEEDED

slots it may be seen that any arrangement of crosspieces could easily be made to suit any mold.

A study of the design of the drying and annealing ovens and the operation of the open-hearth furnace reveals additional innovations which have been originated to reduce operating costs. Two car-type drying ovens are provided. These ovens have doors at both ends so that cars may be placed or removed through either end. One of the ovens is shown in Fig. 7. In this illustration a car of molds has been pulled from the oven and awaits unloading. The car is drawn from the oven by the crane shown in the illustration. A steel cable attached to the end of the car is passed through a sheave anchored in the floor opposite the oven door and is engaged by the crane hook. When the hook is raised the car is drawn forward. The same crane lifts the molds from the car and places them for pouring.

Heat Conserved

The ovens are built so that one sidewall is common to both as shown in Fig. 9 This reduced the first cost of the ovens and also conserves heat, for when both ovens are used simultaneously, heat does not escape to the outside through this wall but goes from one compartment to the other. Each chamber is 17 feet 7½ inches wide by 50 feet long by 11 feet 10 inches high from the platform of the truck which forms the oven bottom. This gives a large space to heat, and in order to conserve heat when a full charge is not available for drying, arrangements have been made to use only half of the oven. The division is secured by the use of a kinnear rolling door in the middle, as illustrated in Fig. 8. When the door is left down on a sand seal between the two cars, the half of the oven which is not charged is cut off.

The drying ovens are heated with anthracite coal, pea size being used. A fan C, Fig. 9, with a capacity of 6550 cubic feet per minute furnishes the blast. The heat goes up through the port along the inside wall of each oven into a long narrow chamber, marked *heat* in the illustration. This chamber extends the entire length of the oven and is covered at intervals with steel plates. These plates may be moved to regulate the flow of heat into different portions of the chamber and thus maintain an even temperature throughout the oven. After passing over the molds the gases are drawn out through ducts along the outside walls by fans. Unlike the arrangement for the blast in which one fan serves both ovens, a separate fan is provided for the exhaust of each. The fans both have a capacity of 3000 cubic feet per minute. The exhaust fans serve to draw the moisture from the cores and molds out of the ovens and have proved efficient for this purpose. Heat is prevented from escaping around the bottom of the trucks by a sand seal. The temperature is regulated according to pyrometers. Cores are heated to from

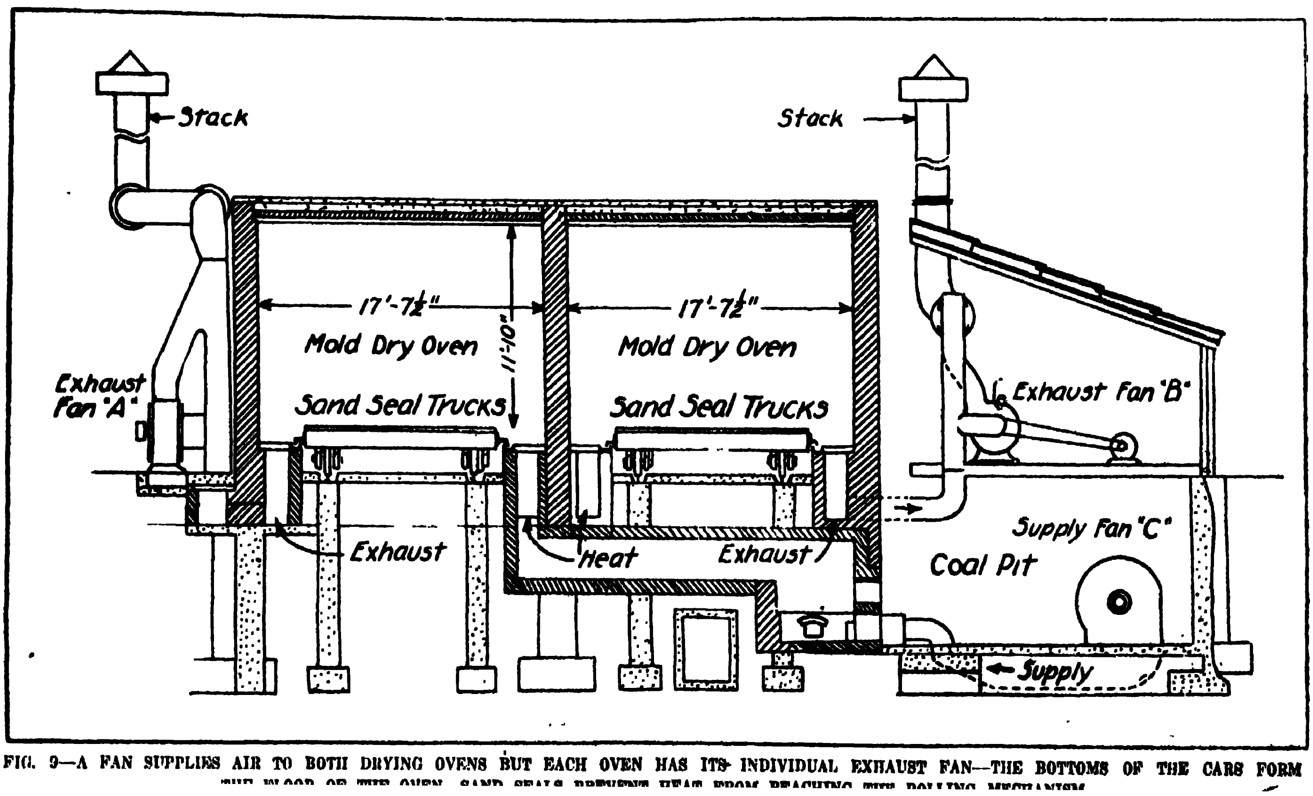


FIG. 9—A FAN SUPPLIES AIR TO BOTH DRYING OVENS BUT EACH OVEN HAS ITS INDIVIDUAL EXHAUST FAN—THE BOTTOMS OF THE CARS FORM THE FLOOR OF THE OVEN. SAND SEALS PREVENT HEAT FROM REACHING THE ROLLING MECHANISM

400 to 450 degrees Fahr. and molds are dried at from 700 to 900 degrees. The difference in temperature for drying the molds is accounted for by the size of the molds to be dried, larger molds requiring a higher temperature and a greater length of time than the smaller molds. The majority of the molds can be dried in 7 to 10 hours.

In addition to the two ovens described, two drawer-type core ovens have been installed for the smaller cores. These ovens also are heated with anthracite coal and equipped with thermometers. All ovens are designed so that fuel oil may be burned in place of coal should this be found expedient at any time.

Will Establish Branch in Nitro, Va.

The first commercial industry to locate at Nitro, W. Va., formerly the war department's "smokeless powder city" will be the Central Foundry & Supply Co., Columbus, O., which has purchased a factory site from the original purchasers, the Charleston Industrial Corp., of Charleston, W. Va. The sale has been approved by the ordnance salvage board and the director of sales, in accordance with a contract under which the government sold Nitro to the Charleston corporation last December. The site which was selected by the Central Foundry & Supply Co. consists of 5½ acres and contains such buildings as a sheet metal shop, a brass and iron foundry, a pipe and electric shop, a welding shop and numerous smaller structures. The purchasers will establish a branch plant at Nitro.

Apprentices Should Have Theory Training

By O. J. Rice

Believing that every man employed in an industry is an integral part of that industry and that the training of men should have at least as much attention as the improvement of machinery, I submit the following in support of C. C. Schoen's paper published in the Jan. 15 issue of THE FOUNDRY. My experience and observation gained in twenty odd years in the foundry industry leads me to believe that there is little attention paid to the development of good mechanics. In fact most of the competent mechanics have been developed in spite of the management rather than by the aid of the executive force. I have heard foundry managers lament the lack of skill and ability on the part of their employes. They seem to forget that these men were trained in some foundry, and they are limited by their training. Some men have labored under the delusion that the machine would eliminate the skilled molder, but have discovered later that intelligence and training were a considerable asset, even in the operation of a machine.

The United States government maintains apprentice schools in several of its manufacturing establishments and as a result there is more or less improvement in the skill and knowledge of its employes depending to a considerable extent upon the ability of the instructors and the attitude and support of the management.

There are many sound and pertinent suggestions in Mr. Schoen's paper that should be worked out. There could and should be established in every foundry center by the American Foundrymen's association, a school for foundry apprentices, making it a condition of employment, that the apprentice should attend this school. These schools should be presided over by practical foundrymen with the assistance of the technical instructors in our established schools. The cost is not worth considering in view of the great amount of money spent on other forms of experimental work. It has been fairly well established that the practical man (intelligence being equal) is superior in some respects to the technical man, and it follows by the same line of reasoning that the practical man who has supplemented his knowledge by a technical training should be superior to both.

Book Review

Little Known Facts About Grinding, by Howard W. Dunbar; leatherette, 174 pages, 4½ x 7 inches; published by Norton Co., Worcester, Mass.

In this book Mr. Dunbar has collected a number of practical articles and suggestions on grinding that have appeared from time to time in *Grits and Grinds*, a house paper published by the Norton Co. for several years. The book is divided into two sections, the first being devoted to little known facts while the other describes practical grinding kinks.

The first section of the book covers 41 separate subjects, each of which is treated in a comprehensive manner. An interesting chapter is devoted to grinding machine operations in which various points that should be given attention by every operator are described. Another interesting chapter pertains to cam checking and actual instances of how trouble with cams checking during the grinding operation was overcome, are given. Among other interesting subjects covered are: Wheel truing, wheel grades, surface grinding, chatter marks, cam grinding, wheel balance, steady rests, soft wheels, grinding lubricants, etc.

The grinding kinks furnish interesting reading as they are taken from actual working conditions and show economical methods for handling grinding in actual production work. The book is well written in clear, comprehensive language and it will prove an excellent handbook for the grinding machine operator, the grinding room foreman, the mechanical engineer and the student of grinding.

Investigate Method for Determining Oxygen

Equilibrium conditions in the system carbon, iron oxide and hydrogen in relation to the Ledebur method for determining oxygen in steel were studied by the bureau of standards. The results are published in scientific paper No. 350 of the bureau. The conclusions of this investigation are that graphite does not reduce ferrous oxide or water vapor at 900 degrees Cent. if hydrogen is passing at the rate of two liters or more per hour.

Combined carbon in iron reduces ferrous oxide, with formation of carbon monoxide, under the foregoing conditions, to an extent varying with the proportion of carbide present.

The percentage of ferrous oxide reduced by hydrogen from a mixture of iron carbide with ferrous oxide is a function of the rate of passage of the hydrogen and, as shown by experiments in this paper, reaches a maximum of 75 per cent reduction when hydrogen passes at about three liters per hour. The remaining oxygen is evolved principally as carbon monoxide and partly as carbon dioxide.

The Ledebur method under most favorable conditions probably can not account for more than 75 per cent of the oxygen present in a steel as ferrous oxide.

The Hagerstown Homes Corp. has been organized by approximately 50 manufacturers, merchants and bankers of Hagerstown, Md., and to relieve the acute situation existing in that community due to the house shortage, this corporation is preparing to build annually 100 or more modern houses for workmen. These houses will sell for about $3500 each and may be purchased on an easy payment plan. Thomas W. Pangborn, president of the Pangborn corporation, is president of the Housing Corp.; John J. Porter, vice president of the Security Lime & Cement Co., is first vice president, and Henry Holzapfel Jr., second vice president.

Graphitization of White Cast Iron

Experiments Show Results Which Would Revolutionize the Theory of Annealing Malleable Iron — Graphitization Completed in White Cast Iron at Temperatures Below the Critical Point

BY R. S. ARCHER

Investigations Enlighten Annealer

ANNEALING is one of the principal steps in the manufacture of malleable-iron castings. This process is carried on to change the carbon, which is all in the combined state in the original hard iron, into free or temper carbon. The operation sometimes is known as graphitization. The first rules for annealing were evolved from experience based on certain given conditions and a limited knowledge of the metallurgy of malleable. More recently investigations have been carried out to determine the effects of different annealing temperatures on the product. Some of these experiments have revealed important facts and have in a measure changed annealing conditions in a number of foundries. The paper here presented reveals some new facts which should be helpful to the industry, in that they show complete graphitization occurs at a temperature below the A_1 point, and that it cannot be completed at a temperature close to this point.

THE proper representation of equilibria involving graphitic carbon in the constitutional diagram of the iron-carbon system is admittedly an unsolved problem. The complete solution of the problem will probably require the establishment of more experimental evidence than is at this time available. This paper presents the author's observations on some of the phenomena in question and his interpretation of this and other recorded evidence. The chief of the recently disputed questions upon which the author has experimental evidence concerns the occurrence of graphitization at temperatures below the A_1 point. In a paper presented at the September, 1919, meeting of this Institute, the following is found: "The results given would seem to indicate that the graphite eutectoid lies at a smaller value of carbon content than has been previously supposed. At least this is true unless there is either a marked formation of graphite eutectoid at these rates of cooling, or a decomposition of pearlite into graphite, both rather unlikely suppositions, but not impossible ones."

In a discussion of this paper, H. A. Schwartz takes the position that the possibility of graphitization occurring below the A_1 point is an open question, but that complete graphitization, to less than 0.10 per cent combined carbon, commonly occurs above this temperature.

Another opinion from the malleable castings industry is found in a recent paper by Touceda: "Also the carbide of iron can be broken up into its two soft constituents at the temperature referred to. This temperature is called the critical temperature, or critical range, and for air-furnace hard-iron castings it is in the vicinity of 1440 degrees Fahr. It is the lowest temperature at which hard-iron castings may be successfully annealed. This statement must be modified by the further statement that in an oven under perfect control this temperature is the one that would be selected. In practice, it would not be safe to adhere too closely to it, for the reason that should the castings while being held at temperature fall under the critical range, it would undo in large measure what had been accomplished above it." It is not certain that the "critical temperature" referred to is understood by Touceda to be the A_1 point of the iron-cementite system, but 1440 degrees Fahr. is certainly at or above the A_1 point of the hard-iron mentioned. It therefore seems to be his opinion that graphitization cannot be carried out below the A_1 point, and that heating a partly graphitized iron below this temperature will cause a reversal of the process.

The author questions the statements quoted and will try to show, first, that graphitization can be initiated and completed, to less than 0.05 per cent combined carbon, at temperatures below the A_1 point; second, that complete graphitization is possible only at or below a point which is very close to, if not identical with, the A_1 point.

Practically all of the available evidence on graphitization concerns iron-carbon alloys rather high in silicon, since these are the most easily graphitized. It is therefore important to know the effect of silicon on the position of the A_1 point. Some determinations of the Ar_1 point recorded in the literature show it to range from 730 to 750 degrees Cent. An unpublished heating curve plotted from data taken in the laboratories of the General Motors Corp., Detroit, by C. Pfeifer gives 760 degrees Cent. as the Ac_1 point for an iron containing 0.85 per cent silicon. These results are all consistent, with the possible exception of that of Charpy. The conclusion seems justified that the presence of 1 per cent of silicon raises the Ac_1 point to at least 740 degrees Cent. (1364 degrees Fahr.) and more probably to about 765 degrees Cent (1409 degrees Fahr). Since graphitization is a slow process, the critical temperature in question is the A_1 point, which is generally considered to lie between Ar_1 and Ac_1, but much nearer to Ac_1. For a 1 per cent silicon iron, A_1 is probably within 15 degrees Cent. of 750 degrees Cent.

In a previous paper, rates of graphitization at various temperatures were given for a hard-iron containing 1.05 per cent silicon. Two of the annealing treatments carried out for the determination of these rates are believed to have been conducted entirely below the A_1 point and there is no question that they produced complete graphitization. The mean temperatures were 690 degrees Cent. and 735 degrees Cent. and no deviations from these temperatures greater than 15 degrees Cent. were observed during the heat treatments. The furnace used was not automatically controlled nor was a temperature recorder available. Therefore the following indirect evidence is submitted that the annealing temperatures remained below A_1. Microscopic examination of every specimen of the two series showed that in all cases the pearlite was in the *divorced* state. This could not have been the case if the temperatures had oscillated about the A_1 point. The results of experiments at 785 de-

A paper prepared for the New York meeting of the American Institute of Mining and Metallurgical Engineers. R. S. Archer is metallurgist, Aluminum Manufactures, Inc., Cleveland.

FORMULAS FOR THE BRASS FOUNDRYMAN

Hardening Effect of Bismuth on Tin

Alloy No. 1	Per cent	Alloy No. 2	Per cent
Tin	99.50	Tin	99.00
Bismuth	0.50	Bismuth	1.00

The hardness of No. 1 alloy unannealed was 11.90, and when annealed 11.75. The hardness of No. 2 alloy was 14.85 unannealed and 14.30 when annealed. With higher percentages of bismuth the hardening effect was more evident.

Alloy No. 3	Per cent	Alloy No. 4	Per cent
Tin	96.00	Tin	92.00
Bismuth	4.00	Bismuth	8.00

The hardness of No. 3 alloy was 26.65 unannealed, and 25.60 when annealed, that of No. 4 was 29.25 unannealed, and 28.90 when annealed.

Hardening Effect of Aluminum and Magnesium on Tin

Alloys			Comparative Hardness Averaged		
Tin Per Cent	Aluminum Per Cent	Magnesium Per Cent	Chilled Casting	Annealed 3 Hours	Annealing Temperature Degrees Cent.
99.75	0.25	00	14.25	12.75	210
99.50	0.50	00	16.50	13.50	210
99.00	1.00	00	17.35	14.35	210
98.00	2.00	00	20.15	14.25	210
99.50	00	0.50	20.05	15.80	180
99.00	00	1.00	25.50	15.65	180
98.00	00	2.00	31.85	18.50	180

In the above tests the great hardening effect of magnesium is illustrated and in this connection the great effect that annealing has in softening these alloys may be pointed out.

FORMULAS FOR THE BRASS FOUNDRYMAN

Comparative Hardness of White Metals

The following results in regard to the hardness of white metals were obtained by the researches of P. Ludwik. The tests were made by the conical impression method.

Alloys				Comparative Hardness		
Tin Per Cent	Lead Per Cent	Antimony Per Cent	Copper Per Cent	Chilled Castings	Annealed 3 Hours	Annealing Temperature Degrees Cent.
96.00	4.00	00	00	13.35	14.55	150
92.00	8.00	00	00	16.00	14.30	150
85.00	15.00	00	00	15.50	14.15	150
70.00	30.00	00	00	11.50	12.70	150
50.00	50.00	00	00	9.90	10.15	150
96.00	00	00	4.00	12.75	11.75	200
92.00	00	00	8.00	15.50	14.55	200
85.00	00	00	15.00	24.30	23.45	200
96.00	00	4.00	00	16.60	14.80	200
92.00	00	8.00	00	21.10	21.15	200
85.00	00	15.00	00	25.25	23.00	200
70.00	15.00	15.00	00	20.35	22.35	150
55.00	30.00	15.00	00	15.10	18.55	150
88.00	00	8.00	4.00	27.20	23.60	200
84.00	00	8.00	8.00	30.15	27.70	200
81.00	00	15.00	4.00	29.30	26.60	200
77.00	00	15.00	8.00	33.90	33.20	200

From the above it will be noted that lead has a softening effect on tin, and that copper and antimony together have the greatest hardening effect.

Hardness of Alloys of Tin and Zinc

Alloy No. 1	Per Cent	Alloy No. 2	Per Cent	Alloy No. 3	Per Cent
Tin	99.50	Tin	99.00	Tin	96.00
Zinc	0.50	Zinc	1.00	Zinc	4.00

The hardness of No. 1, was 11.15, unannealed and 10.35 annealed. Of No. 2, 14.10 unannealed and 14.15 annealed, of No. 3, 17.00 unannealed and 15.45 annealed.

Table II

Progress of Graphitization in Malleable Iron

Test No	Annealing Temperature Degrees Cent.	Annealing Temperature Degrees Fahr.	Time at Heat, Hours	Total Carbon, Per Cent	Graphitic Carbon, Per Cent	Combined Carbon Per Cent
D-1	690	1274	24	2 80	0.06	2.83
D-2	690	1274	47	2 75	0.47	2 28
D-3	690	1274	75	2.87	1.31	1.56
D-4	690	1274	95	2.87	1 82	1.05
D-5	690	1274	119	2.80	2.33	0.47
D-6	690	1274	149	2.77	2.49	0.28
D-7	690	1271	168	2 75	2.70	0.05
D-8	690	1274	193	2.68	2.68	None
D-9	690	1274	221	2.76	2.75	None
C-1	735	1355	11	2 92	0 12	2.80
C-2	735	1355	24	2.90	0.39	2.51
C-3	735	1355	37	2 93	1 27	1.66
C-4	735	1355	48	2.78	1.83	0.95
C-5	735	1355	[illegible]	2 74	2 05	0 69
C-6	735	1355	[illegible]	2.74	2.31	0.43
C-7	735	1355	84	[illegible]	2.42	0.34
C-8	735	1355	96	2.68	2.50	0.18
C-9	735	1355	120	2 58	2.51	0.07
C-10	735	1355	150	2.56	2.51	0.05

grees Cent. showed that at that temperature, which is not far above A_1, an annealing period of 10 hours produced about 0.5 per cent of graphitic carbon in this iron. In the 690 degrees Cent. treatment, only 0.06 per cent graphitic carbon was found after 24 hours. The progress of graphitization during the 690 degrees Cent. and 735 degrees Cent. treatments is shown in Table I.

The material used for these experiments was a lot of hard-iron bars ⅝ inch square cast from a single ladle of metal in a green-sand mold. The analysis was: Total carbon, 2.90 per cent; graphitic carbon, none; silicon, 1.05 per cent; manganese, 0.35 per cent; sulphur, 0.035 per cent; phosphorus, 0.11 per cent The test pieces were heated in a wire-wound electric furnace and due precautions were taken that the temperatures indicated were correct and represented the actual temperatures of the test pieces. The furnace chamber was filled with charcoal but not in contact with

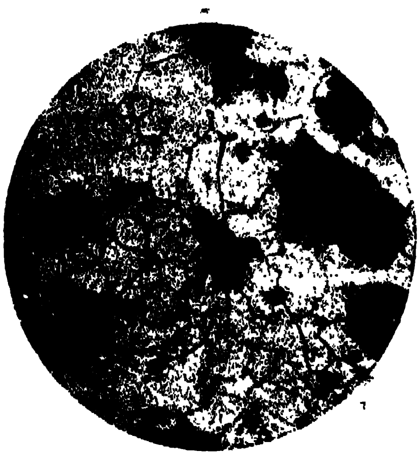


FIG 1 MICROGRAPH OF MALLEABLE IRON REHEATED TO 749 DEGREES CENT.

the test pieces. This resulted in fairly satisfactory protection from decarbonization, and microscopic examination showed that in no case was a ferrite

Table I

Solubility of Graphite in Iron

Test No.	Annealing Temperature Degrees Cent.	Annealing Temperature Degrees Fahr.	Time at Heat, Hours	Total Carbon, Per Cent	Graphitic Carbon, Per Cent	Combined Carbon Per Cent
F-1	835	1535	5	2.87	0.54	2.33
F-2	835	1535	9.	2.83	1.41	1.42
F-3	836	1535	19	2.80	1.06	0.94
F-4	835	1535	24	2.76	1.93	0.83
E-1	785	1445	41	2.76	1.76	1.00
E-2	785	1445	45	2.80	1.87	0.93
E-3	785	1445	50	2.72	1.96	0.76
E-4	785	1445	55	2 73	2.07	0.66
E-5	785	1445	65	2.75	2.07	0.68

rim formed. After the specified periods of annealing, the specimens were removed from the furnace and dropped into a box of ashes. The time of cooling from the annealing temperature to below a red heat did not exceed 20 minutes. Opposite sides of the test pieces were ground down about 1/32-inch and drillings taken for analysis, the drill passing through the test piece. From these drillings samples were taken by the parting method. The samples for total carbon were not screened. Both total and graphitic carbons were determined by combustion.

A different line of evidence concerning the temperature ranges of graphitization is furnished by reheating a completely graphitized iron. Specimens were prepared from a malleable test bar in the form of cylinders ⅝-inch in diameter by 1-inch in length. A ⅛-inch hole was drilled down the axis of the specimens to a depth of ½ inch. A thermocouple, especially checked for the purpose, was packed into this hole with asbestos, which insulated the wires of the couple from the sides of the hole and from each other. The specimen was then heated to a specified temperature, the rate of heating being quite slow as the required temperature was approached. The specimen was held at this heat for 15 minutes and then cooled in air.

The structures of two such specimens are shown in Figs. 1 and 2. Both are etched in an alcoholic solution of picric acid and magnified 100 times. It will be noted that the specimen reheated to 749 degrees Cent. (1380 degrees Fahr.) shows no combined carbon, while the one heated to 771 degrees Cent. (1420

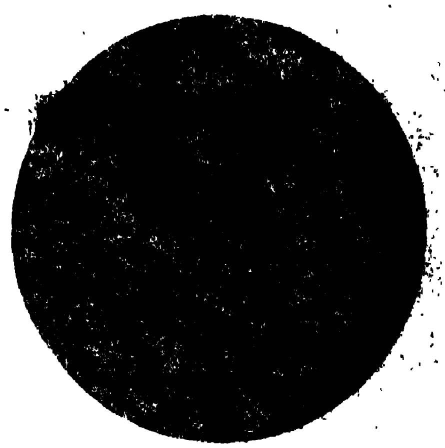


FIG. 2 MICROGRAPH OF MALLEABLE IRON REHEATED TO 771 DEGREES CENT.

degrees Fahr.) does show combined carbon. It was not considered necessary to analyze this material. This reversion of graphitic carbon to combined carbon has been observed and recorded by Touceda, who found no combined carbon on reheating to 760 degrees Cent. but did after heating to 788 degrees Cent. A similar observation is reported by Storey and Leasman.

It therefore appears to be a well-established fact that there is a temperature above which the graphite of a completely graphitized iron will go back into solution, to be reprecipitated on cooling as iron carbide. For iron of the composition used for malleable castings—0.5 to 1 per cent silicon—this temperature is approximately 765 degrees Cent. The conclusion seems inevitable that combined carbon cannot be completely converted to graphitic carbon under conditions that cause graphitic carbon previously formed to

revert to dissolved carbon and, on moderately rapid cooling, to cementite. That is, it is not possible above this critical temperature to completely convert combined carbon to graphitic carbon. If this is true, it follows that the complete conversion regularly obtained in properly annealed malleable castings must, of necessity, take place in its final stages either at or below this critical temperature.

Temperature of Conversion

Whether the completion of graphitization takes place at or below a definite critical temperature is a question of importance. If, as maintained by some of the writers quoted, the complete conversion to graphite takes place at this critical temperature and not below it, such conversion must consist in the direct precipitation of an iron-graphite eutectoid. For if the conversion took place simultaneously with the formation of pearlite, there is no reason to suppose that it would not continue at temperatures slightly below the critical.

When white cast iron is heated sufficiently long at temperatures above 785 degrees Cent., the combined carbon content reaches a constant value for any given temperature. It has been well established that these values increase with the temperature. It is by plotting such values against the temperatures of annealing that the solubility curve of proeutectoid graphite has been obtained. This curve, as Desch remarks, is suspiciously close to the solubility curve for cementite. The author suggests that the solubility curve of graphite can, for practical purposes, be considered to be identical with that of cementite, if due allowance is made for the effect of silicon on the solubility of cementite, and on the temperature of the A_1 change. In the experiments referred to above to determine rates of annealing, some evidence was obtained as to the solubility of graphite in iron containing 1.05 per cent silicon at temperatures just above A_1.

The method of cooling after the annealing period seriously affects the results of such experiments. The test pieces of set *F* were air-cooled after being withdrawn from the furnace. A piece similarly treated but quenched showed a combined carbon content of 0.86 per cent. This may indicate a slight additional precipitation of graphite during air cooling, but the difference is within the errors of analysis. Another test piece was cooled from the same temperature under ashes, as described; the combined carbon content was then 0.67 per cent. This shows that the short time occupied in passing through Ar_1 and through temperatures immediately below Ar_1 was sufficient to allow the formation of nearly 0.2 per cent more graphitic carbon. It is thought that the sensitiveness of such material to slight changes in the cooling rate has not been sufficiently appreciated, and that this accounts for some apparently inconsistent results in the literature.

As stated above, the test pieces of set *F*, after air cooling and after quenching gave consistent results, so that the value 0.85 per cent is considered to be a reliable figure for the solubility of graphite at 835 degrees Cent., in the presence of 1.05 per cent silicon. The test pieces of set *E*, however, were cooled under ashes, so that the results only show the solubility at 785 degrees Cent to be between 0.66 and 0.85 per cent. Since this temperature is only slightly above A_1, assumed to be at 765 degrees Cent., it is thought that this evidence points to a eutectoid composition in good agreement with that given by Guertler 0.70 per cent.

When allowance is made for the chemical effect of silicon and phosphorus, and for the bulk effect of graphite, on the composition of the pearlite eutectoid, it is the author's opinion that 0.70 per cent carbon is so close to the value to be expected that the iron-cementite and iron-graphite eutectoids may be considered as practically identical.

The evidence submitted in this article is thought to demonstrate two facts: That graphitization can be initiated and completed in a white cast iron at temperatures below the A_1 point; and that graphitization cannot be completed at temperaures above a point which is very close to and perhaps identical with the A_1 point.

Theory of Graphitization

It is suggested that the phenomena of graphitization can be satisfactorily explained on the basis of the following theory: First, with the possible exception of the initial stages, graphitization takes place directly from solid solution: Second, graphitization may take place from any solid solution supersaturated with respect to graphitic carbon: Third, the evidence at present available is not sufficient to determine whether the saturation values for a solid solution on the point of precipitating graphite are appreciably different from those for a solid solution on the point of precipitating cementite. Under conditions of equilibrium, two phases are present—graphitic carbon and the saturated solid solution. Metastable equilibrium may exist between the two phases iron carbide and solid solution. Theory indicates that the carbon concentration of solutions in stable equilibrium with graphite is less than that of solutions in metastable equilibrium with iron carbide. If the available experimental evidence is considered with allowance for the effect of impurities on the solubility of iron carbide, the solubility curve of the carbide may, for practical purposes, be used to determine the conditions of equilibrium in the stable system iron graphite.

Heat Treatment Strengthens Duralumin

HEAT treatment of duralumin was investigated by P. D. Merica, R. C. Wattenberg and H. Scott of the bureau of standards. The results of the investigation which have been published point out that the unusual feature of this alloy is the fact, as was shown by A. Wilm, that it can be hardened quite appreciably by quenching from temperatures below its melting point followed by ageing at ordinary temperatures, which consists merely of allowing the material to stand at these temperatures. The hardness is not produced by the quenching alone, but increases during the period of ageing, which may be from one to three days. Cohn gives data showing the increase of hardness of duralumin during ageing, after quenching in water from about 450 degrees Cent. Upon annealing the alloy so hardened by ageing, it is softened exactly as is hardened steel.

The composition of this allow usually varies within the following limits:

	Per cent
Copper	3.0–4.5
Magnesium	0.4–1.0
Manganese	0.0–0.7
Aluminum	Balance
Iron (as impurities)	0.4–1.0
Silicon (as impurities)	0.3–0.6

Its density is about 2.8. It is used only in the forged or rolled condition.

This alloy has been produced for some years commercially and is in demand for the fabrication of parts for which both lightness and strength are required, such as for aircraft. Its tensile strength will average 50,000 to 60,000 pounds per square inch after appropriate heat treatment, such as that described by Wilm.

With the purpose of ascertaining whether the treatment described by him actually developed the best mechanical properties possible for duralumin, a

study was undertaken of the effect of variation in heat-treatment conditions, that is, quenching temperature, ageing temperature, etc., upon these properties and, a study of the effect of chemical composition upon them.

Details of the tests including micrographs showing the microstructure of duralumin are given.

Conclusions are drawn relative to the best conditions for commercial heat-treating practice for this alloy. The temperature of quenching should not be above that of the $CuAl_2$ aluminum eutectic, which is usually about 520 degrees Cent., but should be as near to this as possible without danger of eutectic melting. The pieces should be held at this temperature from 10 to 20 minutes and quenched preferably in boiling water. The hardening may for most purposes best be produced by ageing for about five days under a temperature of 100 degrees Cent.

A theory of the mechanism of hardening of duralumin during ageing, after quenching from higher temperatures, was developed which is based upon the decreasing solubility of the compound $CuAl_2$ in solid solution in aluminum with decreasing temperatures from 520 degrees Cent. to ordinary temperatures. It is believed that the precipitation of excess $CuAl_2$ which is suppressed by quenching proceeds during ageing, the precipitation taking place in very highly dispersed form. The hardening is due to the formation of this highly dispersed precipitate.

According to this theory the hardening of duralumin during ageing or tempering after quenching presents a very close analogy with that of steel, and the evidence in support of the theory is of the same nature and of approximately the same competence as that in support of the prevailing theory of the hardening of steel.

How and Why in Brass Founding

By Charles Vickers

Sands For Brass Casting

We are making a quantity of plain sleeve and flange bushings ranging in weight from 3 pounds to 50 pounds each. The larger castings are molded upright; are gated at the bottom with two gates which spread from the bottom of the sprue like a crescent, often known as a frog gate, and the fall of the metal is broken by offsetting the sprue at the cope joint. The molds are rammed on plain jolt machines, and a green sand core is used for the inside of the bushing. The alloys used consist of the following mixtures: (1) copper, 88 per cent; tin, 10 per cent; zinc, 2 per cent. (2) Copper, 80 per cent; tin 10 per cent. lead 10 per cent. (3) Copper, 85 per cent; tin 5 per cent; zinc 5 per cent; lead, 5 per cent. (4) Copper, 83 per cent; tin, 4 per cent; lead, 6 per cent, and zinc 7 per cent. The difficulty we experience is caused by small sand holes in the surfaces of the castings. The difficulty is not constant we will have none of it whatever for several months, then all at once with the same work, gated in the same way and all other conditions apparently identical, we will find the castings machining hard, small pockets of sand close to the surface, sometimes on the inside, sometimes on the outside of the castings. We have established to our satisfaction that the sand does not come from the cores; it appears to get away from the gate, and from the mold in small particles. We are sending a sample of the sand for inspection. This sample has been used, and is an Albany No. 0 purchased some time ago. Can you advise us as to the cause of this difficulty, and just what is the matter with the sand? We make about 5 tons of castings from each heap of sand per month, and every month we dry all the sand, and put it through a fine riddle, then add about 30 per cent of new sand.

An examination of the sand shows it to be a good grade of No. 0, brass molding sand. When wetted, the moisture soaks right into the sand showing that it does not contain too much clay for molding purposes. On the contrary it appears to lack bond and if the sand heaps are all like the sample it would appear the sand will require to be worked quite damp to get the necessary stability for the mold. This would favor scabbing and cutting, of which there are many degrees; one of them being the trouble experienced. The practice of drying the sand monthly is excellent from the viewpoint of metal recovery, but it fails to keep the sand piles in condition. This can be done only by the constant addition of new sand.

It would appear that additions of new sand are only made at monthly intervals, when it should be made two or three times a week. Regarding the intermittent character of the trouble, the reason for this can only be determined as a result of a careful study of the sand piles from day to day to determine if the sand gets progressively weaker, and if, when this occurs, the difficulty from sand deposits appears in the castings. This study would show if it is possible to eliminate the difficulty by the use of a stronger molding sand. This study should be undertaken for the satisfaction of all concerned, as there is no mystery about the disappearance and recurrence of the sand specks in the castings. They are due to natural causes, and can be eliminated by an analysis of the situation.

However, there is a shorter cut to the elimination of the difficulty. It is all caused by the use of too fine a sand for the weight of the castings. A thin-walled bushing 12 inches deep as some of the castings are, should never be molded in a No. 0 sand. If the sand has the necessary plasticity, it will be too close, if it has the necessary openness as in the present case, it will lack strength, and it will wash either *en masse*, or in single grains before the entering metal, the result being different in degrees, but the same in character. It is a mistake to assume that a coarse sand produces a rough casting; it will only do this for a certain character of castings. Thus for chandelier castings, it is necessary to use a fine grade of sand, otherwise, they will be too rough. This applies also to all thin, light work. For machinery castings, bushings, etc., a No. 1 sand will produce a smoother casting than the finer grades of molding sand. A No. 1 sand is as fine as should be used for making bushings as large as the ones mentioned. We suggest that a few barrels of both No. 1 and No. 2 molding sand be procured for experimental use. The addition of about 50 per cent of one of coarser sand to the present piles will cure the trouble. A sand is required that will vent freely, but will contain sufficient bond to prevent the individual grains from being washed away by the streams of metal, and also will not flake. When the sand is too fine for the weight of the casting, spots covered with a greenish coat, that are difficult to brush off will be

observed in cleaning the castings. Underneath these greenish spots defects usually are located. The remedy is to use a coarser sand, even if this necessitates throwing away the entire molding sand supply that has been in use.

Brass Hardware Castings

We intend to make brass castings for furniture hardware using an alloy containing copper, 65 per cent, and zinc, 35 per cent. We would like to know what the loss will be with this alloy and what will be the best way of melting it. Also we would like to get the dimensions of furnaces burning coke with forced draft suitable for Nos. 50 and 25 crucibles and what is the best kind of coke to use in this connection.

The loss in melting yellow metal will vary with the melter and the kind of furnace that is used. The average melting loss in oil-fired furnaces may be placed at 4 per cent. Some founders cut this loss in half and with others it is much higher. Melting in a crucible can be figured as not excessive if the loss is kept to 3 per cent, but this figure may be improved upon. The best way of melting this alloy is in crucibles. If new metal is made, charge the copper first and melt under a cover of charcoal, with a little salt as a flux. Have the zinc warm at the start and add a few small pieces to the copper, then follow with the larger pieces. Do not hold the brass in the furnace but remove it as quickly as the pouring temperature is reached. This temperature may be determined for thin castings, by holding an iron bar in the metal and noting the tremor that is communicated to the bar. If no tremor is felt the metal is too cool to pour. A No. 50 crucible coke-fired furnace should be 17 inches in diameter inside the firebrick and the depth of shell should be 28 inches. For a No. 25 crucible, the furnace should be 14 inches in diameter and 25 inches deep. These dimensions permit the use of coke that is not broken too finely to burn well. A No. 35 crucible is a good size for yellow brass, and the furnace should be 15 inches in diameter. A coke low in sulphur should be used.

Casting Iron Around a Brass Lining

We have tried to cast a heavy veneer of brass onto the bearing portion of a cast iron pillow block. We first cast the brass, then incorporate it into the core that forms the bearing and set it into the mold, then pour the cast iron into the mold. The difficulty is caused by the brass becoming liquid, and remaining in that condition long after the iron has solidified, during which period, owing to the great degree of fluidity imparted to the brass, it seeps into the sand backing of the mold and core, also the fluid brass follows up the shrinkage of the cast iron, getting between the latter and the sand of the mold, the result being that the brass is taken away from the bearing part where it is wanted. We would like to learn if a cast iron chill back of the brass would prevent the latter from melting. Also if it would be possible to cast the brass into the iron without the shrinkage producing a loose fit.

As the brass is entirely enclosed by the iron on all but the curved side, and the iron is 3 inches thick, it is doubtful if a chill behind the brass would keep the latter entirely in a solid state. However the chill would greatly aid in keeping the brass from melting, especially if the iron is poured at as low a temperature as is possible to pour the casting. On this account, it is worth a trial. The brass would have to be in intimate contact with the chill to derive any benefit from its chilling influence. Casting the brass onto the iron can be done, provided the iron is hot and the brass is flowed through the mold. However, the shrinkage of the brass might cause it to become loose. We believe that if a chill is placed against the brass, and a riser on the mold over the brass, and the iron is poured cool that a successful job can be made. After the iron is poured, look down the riser at the brass, if it is liquid and has seeped away, fill up the riser with liquid brass. If the iron melts the brass quickly enough to enter the brass riser, plug the latter with a core until the iron is set.

Fluxes To Clean Solder

We are having difficulty with a flux for cleaning solder. We are using a mixture consisting of rosin, 5 pounds; salammoniac 5 pounds; charcoal powder, 5 pounds, and sulphur powder, 12 ounces. We mix this flux and after the solder has melted and has reached a temperature of 450 degrees Fahr. we put in 6 or 7 small ladles of the flux. We then work the bath for about 15 minutes, running the temperature up to 550 degrees until the mixture cakes, then we skim carefully. We ought to be able to commence dipping the metal out when it reaches 510 degrees, but are unable to do this on account of the accumulation of heavy metal under the surface of the solder. This latter is not a powder, but a heavy, white metal. We use brass for dipping. We would like to be informed why this dross or foreign enemy of the solder is not worked out.

The difficulty is caused by the incorporation of sulphur in the flux. We suggest the sulphur be eliminated, the salammoniac reduced at least 50 per cent and the rosin increased. After the metals are melted a little of the reconstructed flux should be added and the bath of solder should be thoroughly stirred for a considerable period, the longer the stirring the better mixed will be the solder. In dipping brass, some of the metal is dissolved with the result that copper and zinc enter the solder. The copper causes a thickening of the solder and when this occurs the old flux with sulphur should be used to clean the bath. The sulphur will combine with the copper, and this will produce some thick metal which should be removed, for refining. The salammoniac will act favorably on the zinc, with the result that the metals which harm the solder are largely removed. Unless the bath has become thick after a lot of brass has been dipped, it will do harm to use sulphur as the latter will combine with the metals composing the solder to the detriment of the latter.

Self Lubricating Bearings

We have orders for special bearing bronze that must be used in a position where it cannot be lubricated. The bearings will operate against highly finished commercial machine steel, at a maximum speed of 200 revolutions per minute. The pressure on the bearing will be approximately 50 pounds per square inch. The conditions not being severe, with the exception of lack of lubrication, we thought that an alloy of copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent, might meet the requirements. Please let us have your opinion in regard to this matter.

The alloy mentioned is a good ordinary bearing metal, but whether it will run cool under the circumstances is doubtful. There are so many different and ingenious methods of lubricating moving machine surfaces that it ought to be feasible to supply lubrication to the bearing mentioned. Possibly a more highly leaded alloy would be superior to the 80-10-10 alloy. You might try an alloy of copper, 77 per cent; tin, 8 per cent; lead, 15 per cent. Melt the copper, add the tin and then the lead. The result is an excellent bearing alloy.

Tough Brass Alloys

We would like to obtain the formula for a strong alloy suitable for use at temperatures around 650 degrees. The castings are simply rings.

The following alloy will be quite suitable for the purpose outlined. Copper, 90 per cent; tin, 5 per cent, and phosphor tin, 5 per cent. The grade of phosphor tin containing 5 per cent phosphorous should be used.

Measuring the Temperature of Steel

The Use of Thermo Couples, Radiation and Optical Pyrometers in Measuring the Temperature of Molten Steel Is Considered—How the Rod, Film and Pouring Tests Are Employed

BY F. W. BROOKE

A LARGE number of trials and experiments have been carried out by steelmakers along with the commendable support of the makers of pyrometers to try and place the measurement of molten steel upon a scientific and fairly reliable basis. Most of the practical investigators have known that the measurements of actual temperatures to any degree of accuracy at present is impossible and have contented themselves with the results of comparative tests.

The thermocouple for temperatures of heat treatment has proved valuable. In the measurement of molten steel, however, only the rare metal couples can be considered, and even these do not withstand the severe conditions of such a bath The mechanical strength of a long tube at the high temperature is inadequate; the chemical reaction of the slag in the case of basic operation is undesirable; and the varying thickness of the coating of slag to the tube as it is pushed through causes a varying lag of temperature from the steel to the couple.

Radiation Pyrometers

The radiation pyrometers require no focusing and the method of handling them is simple. These instruments have an attachment for taking care of the change in black body conditions from true black body conditions when steel is poured from a furnace or from a ladle. The first obvious objection to the use of this instrument is that owing to the slag covering in the furnace, the temperature cannot be read until the steel is being poured from the ladle. This only allows for correction of temperature in one direction. If the temperature of the steel is too low, preference can be given to the heavy castings of large section. If the temperature is on the high side the steel can be left in the ladle, or preference given to all the small castings requiring a relatively high temperature; but perhaps the greatest value is a check and guidance for the melter and foundry superintendent on the more or less crude practical methods now existing. The principal objection to the use of radiation pyrometers lies in the difficulty of focusing through a clear atmosphere and on a clean stream of steel. In actual practice it is found that smoke and incandescent gas are constantly interfering with accurate reading. In many furnaces the slag comes out of the teeming spout along with the steel and it is difficult to know which of the readings recorded represents true conditions. There is also the tendency on the part of the observer to record the highest reading on the instrument and interference of a small amount of incandescent gas can escape notice. The following readings are typical of many tests made of a stream of steel leaving the nozzle of a ladle when pouring castings of easy section of about 30 to 100 pounds in weight and 0.25 to 0.35 per cent carbon, by the same instrument and same observer, the resulting castings being of first class quality:

Heat No. 7			Heat No. 23		
Mold	Degrees Cent.	Degrees Fahr.	Mold	Degrees Cent.	Degrees Fahr.
1	1510	2750	1	1530	2790
2	1560	2840	2	1540	2800
3	1515	2760	3	1210	2210
4	1740	3170	4	1560	2840
5	1530	2790	5	1490	2710

It is obvious that the readings on the fourth mold of heat No. 7 and the third mold on heat No. 23 were decidedly off although every care was taken on both these heats to get uniform conditions and the error is undoubtedly due to incadescent gas and smoky atmosphere

Optical pyrometers are subject to the same limitations as those of the fixed focus radiation type. They are not so liable to damage by the too close proximity of the molten metal as an observer has less fear of sticking a long tube up to the stream than of bringing his face too near.

Among the practical methods known, the film rod and pouring tests are in constant use at various steel plants. The use of the film test originated from the crucible steel practice. Before drawing the pots containing alloy tool steel, all the melting shop doors were closed, then the pots were pulled after the required stewing and the lids and slag were removed. Alloy additions were made and then the bright surface of the steel carefully watched for the first sign of an oxide film forming, this being regarded as the sign to commence pouring the metal.

In electric furnace practice the film test is carried out by using a steel spoon of uniform capacity, dried out thoroughly over the bath and giving this a total covering of slag in the furnace. A sample of steel should then be taken, which fairly represents the whole bath, remembering that when a door has been left open for some time the steel near the door has become chilled. With steel made in an electric furnace where all the heat is applied at the top only, the temperature of the steel directly under the slag is higher than the temperature of the steel near the bottom. Where this is the case the bath must be thoroughly rabbled before any sample is withdrawn, and even then the sample should be taken from a point equidistant between the electrodes and half way down the bath, so as to arrive at a fair average temperature. The measurement of the temperature is indicated by the length of time it takes for an oxide film to form completely over the sample.

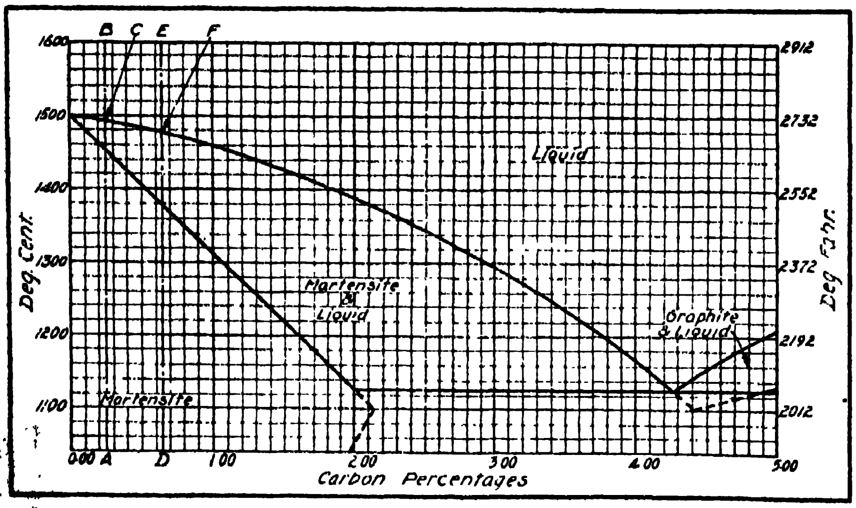
Film Test Varies

Final comparisons must only be made between steels of approximately the same composition and when the furnace is ready to pour. Care must be taken to keep the sample away from drafts and to have about the same amount of steel in the spoon each time. To show the range of this test it has been noted that first class high-speed steel ingots of a composition approximating carbon 0.65 per cent; tungsten, 17.5 per cent; chromium, 3.75 per cent, and vanadium 1.00 per cent were produced when the film (with a later characteristic wrinkling of the surface) was formed directly the sample spoon came through the door; while good castings of about 0.25 per cent carbon and weighing from 30 to 100 pounds were produced when the film took 60 seconds to form after passing through the furnace door.

The rod test has been used for many years to get a rough indication of the temperatures of many molten metals. This test requires the use of steel rods of uniform diameter and fairly uniform composition. The test consists in plunging the rod into the bath of steel for a uniform length of time. If the steel is cold a deposit of the bath forms on the rod, while if the steel is hot

Abstract from a paper presented at the Philadelphia convention of the American Foundrymen's association. The author, F. W. Brooke, is with the Electric Furnace Construction Co., Philadelphia.

the bath melts away or bites into some of the rod; with all the intermediate conditions indicating varying temperatures. The skin of the bar, it will be noted, has an effect on this test; a newly rolled bar with a bright scaly surface tends to show a colder bath than is actually the case. The bar should be of a uniform temperature before being plunged into the bath and in some steel works this is taken care of by bending about 12 inches or more of the end of the bar at right angles; holding the bar with the bend in a horizontal plane over the bath until it shows the first signs of sagging and then turning the end of the bar into the bath.



STANDARD CARBON TEMPERATURE CURVE FOR STEEL

The pouring test consists of using a spherical spoon of above five inches diameter and carefully slagging up this spoon over the bath. Dip the spoon quickly into the metal so as to get a sample of the steel from about the center of the bath. Withdraw the sample and pour the steel over the lip of the ladle at a slow even rate. The temperature of the steel is noted by its fluidity, and by the amount of steel skull left in the spoon. This test is the one most commonly used among the steel foundries.

For all these practical methods too much emphasis cannot be laid on the fact that they are all comparative tests only and that they depend entirely upon uniform conditions and attention to details. In all cases at least two of these methods should be employed. They do not indicate to the melter the temperature of the steel in degrees Cent. or Fahr. but they do give him a good indication of the degrees of temperature that the steel is above or below the temperature which will give him the best results for the composition of the steel he is handling in relation to the weight and type of casting he is making.

In steel works where the best conditions for the pyrometer can be obtained, there is still the limitations of the instruments themselves. Only the optical and radiation offer a good field for these high temperatures and conditions, and there is little doubt that an error of plus and minus 50 degrees Fahr. in the instrument itself is all that we can ever expect.

The best temperature at which the steel should leave the furnace is that at which the particular steel begins to solidify, plus the loss of temperature from the time the reading is taken to the time when the steel gets to the farthest end of the thinnest section of the casting. It may be asked how are we going to know what these two values are? The first value depends on the composition of the steel, the carbon content being the principal factor. This can be obtained by reference to a standard carbon iron curve like that shown in the accompanying illustration. For a steel containing 0.25 per cent carbon trace the line *A B* until it intersects at *C* giving a value on this curve of 1492 degrees Cent. (2720 Fahr.); for a steel containing 0.65 per cent carbon trace the line *D E* until it intersects at *F* giving a value of 1476 degrees Cent. (2690 degrees Fahr.), and so on. For other elements commonly used in the steel for castings the variations are not of importance and do not compare with the many other sources of error that crop up in reading the temperatures of molten steel in a foundry. The second value depends upon such variables as the heat of the ladle, the thickness of ladle lining, time of reading to pouring, whether molds are of dry or green sand, and surface area of the thinnest sections. All of these factors depend very much on local conditions and constant consultation between the man responsible for steel in the furnace and the man responsible for making up the molds is necessary to get results.

Rolling Type Electric Furnaces Installed

THREE installations of electric arc furnaces recently made in foundries in the state of Washington embody a number of novel features, each of which was demanded by the conditions obtaining in the plant. The unit shown in the accompanying illustration, which is employed by the Vulcan Mfg. Co., Seattle, has a capacity of two tons and is rated at 500 kilowatts. It is of the rolling cylinder type and the charging door is in the end, an arrangement which permits the furnace to set close to the transformer room, therefore occupying an unusually small amount of floor space. The tilting of the furnace is controlled by a 4-way hydraulic valve, shown at the right, which is said to be quick, direct acting and of simple operation. The furnace shell is provided with a dial and pointer to indicate the degree of tilting. This assists the operator in bringing the furnace back to its normal vertical position without shock.

A 500-kilowatt, 2-ton, rolling-cylinder type furnace recently was installed at the plant of the Lamb Machine Co., Hoquiam, Wash. The charging door of this unit is in the cylindrical wall of the shell opposite the spout. The furnace foundation is sufficiently elevated above the main floor of the foundry so that workmen may carry hand ladles away from the furnace without stooping over to pick them up. The ladles are supported by a ladle hanger while the metal is being tapped and workmen therefore may remain at a safe distance until the furnace is rotated to its normal position. When the metal is tapped into crane ladles, the shank ladle hanger is quickly removed. As in the case of the furnace at the plant of the Vulcan Mfg. Co., the tilting is controlled by a hydraulic valve situated at a convenient point safely removed from the danger zone.

The third furnace, which is in the plant of the Malleable Steel & Iron Co., Tacoma, Wash, is rated at 300

kilowatts and is adapted to making special grades of gray-iron and semi-steel. Special castings heretofore unattainable on the Pacific coast are being produced at this plant. A second furnace will be installed, and when it is in operation, one unit will be employed for steel and the other for cast iron.

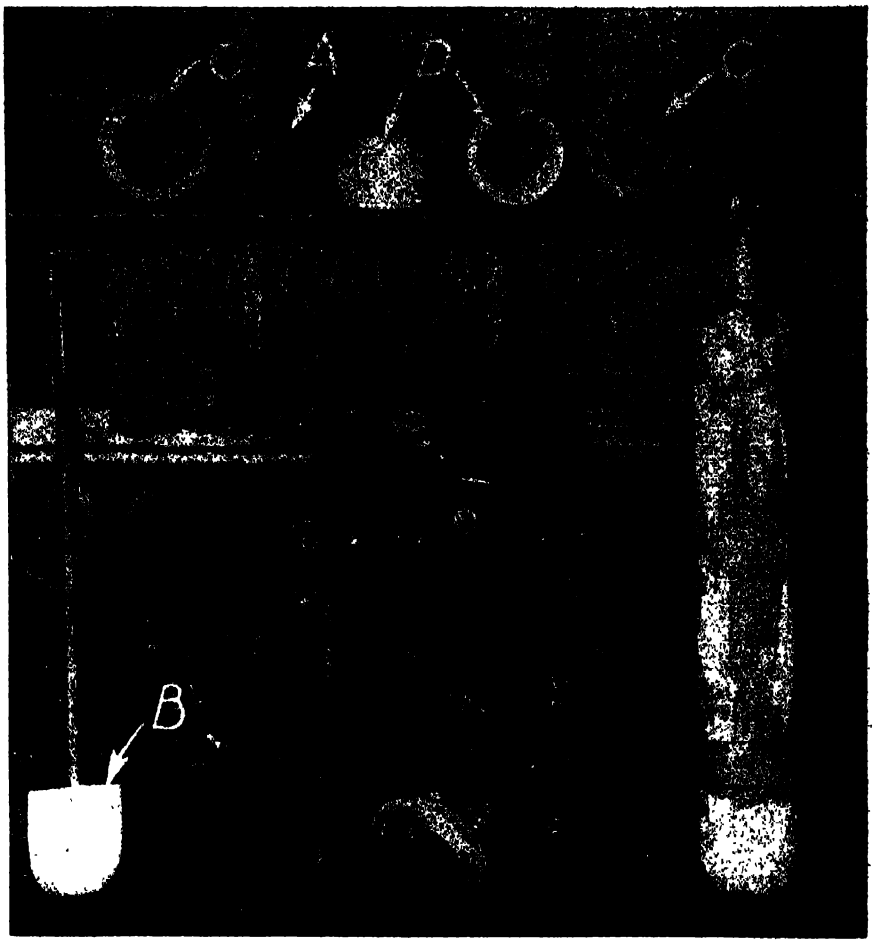
It is claimed that the roofs of these furnaces are of extremely simple design, standard shapes of silica brick being utilized except where the electrodes enter. The charging door shown in the accompanying illustration is operated by a hydraulic cylinder of the double acting type, which enables the operator to stop the door at any desired point. The furnaces were built and installed by the Greene Electric Furnace Co., Seattle.

Make Ladle Nozzles in the Core Room

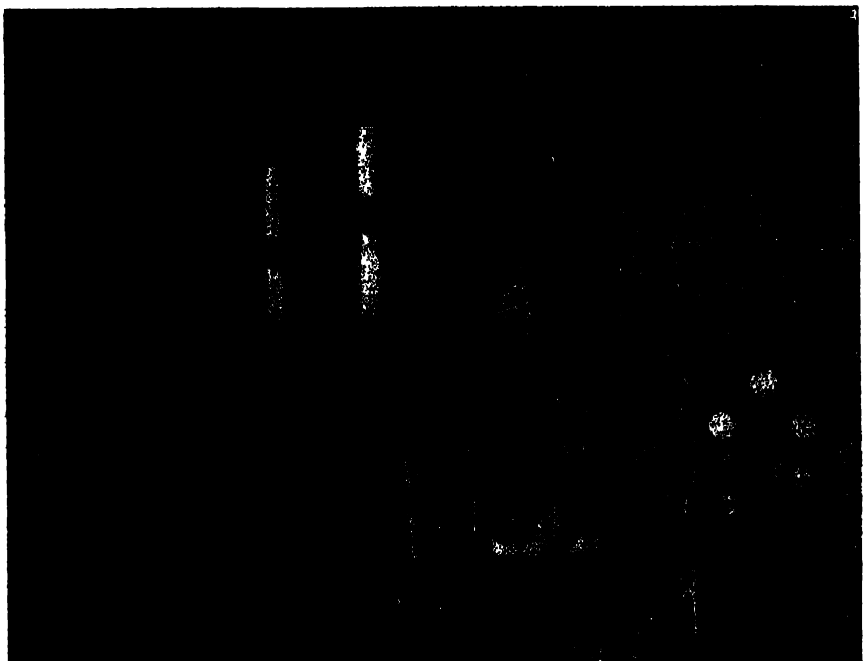
Bottom pour ladles are commonly used in steel foundries but iron foundries almost invariably pour the metal over the lip of the ladle. In a few cases where it is essential to have clean castings and where the castings to be poured are not too small, bottom pour ladles are also used in the gray-iron foundry. A number of shops making car wheels use them exclusively. This class of work lends itself readily to the bottom pour ladle because the amount of metal to be poured on each floor usually is the same during the entire day and it must be poured rapidly. Ladles for this purpose have a capacity of about 1000 pounds and require only a short stopper, which can be made in a much more simple manner than a stopper to be used in a steel ladle, as the latter must hold a far larger amount of metal several hundred degrees hotter than the pouring temperature of gray iron. Should the steel ladle leak, or the stopper fail altogether, the consequences might be serious, but with only 1000 pounds of gray iron in the ladle a leaky ladle seldom would cause much trouble.

For this reason more chances may be taken in making up the stopper in the gray-iron foundry, and some things can be done which would not be practical in a steel foundry. One of these is to make the nozzle in the core room. The different sections which make up a stopper and nozzle for a bottom-pour ladle of 1000 pounds capacity used in the foundry of the Griffin Wheel Co., Chicago, are shown in the accompanying illustration. To make the stopper rod the plumbago stopper

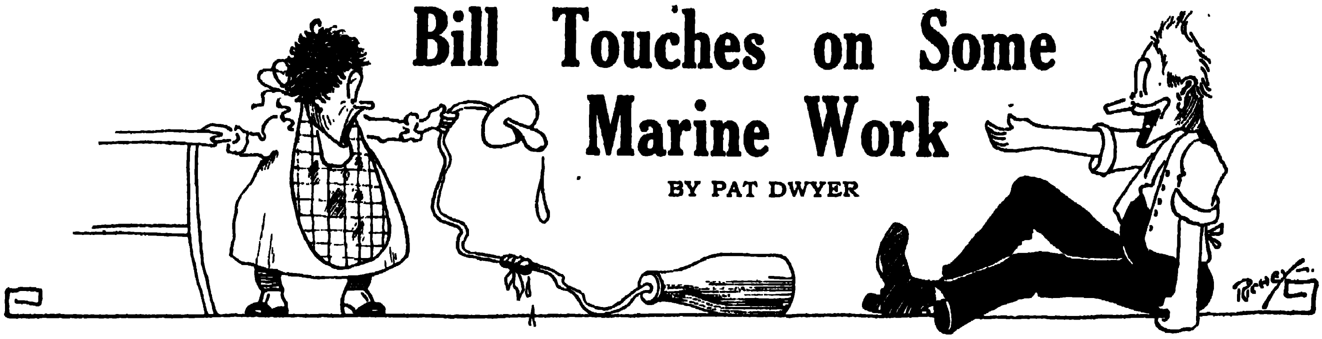
(Concluded on page 205)



PARTS FOR A LADLE STOPPER INCLUDING A MOLD FOR MAKING THE CAST-IRON SUPPORTING RINGS FOR THE NOZZLE



TWO-TON, 500-KILOWATT ROLLING TYPE FURNACE INSTALLED IN SEATTLE PLANT



Bill Touches on Some Marine Work

BY PAT DWYER

DROPPING into Bill's house the other night I found him sitting on the floor teaching a young cherub about a year old how to walk. I advanced the opinion that children should not be forced to walk so early in life as it probably would cause them to have bandy legs and in this specific instance I warned him that when the young lady grew up she would not cherish the same feeling of love, esteem and admiration for her father as she would if her limbs were like the Venus de Milo.

"Nothing in that theory," said he "If there was, every bandy legged molder in the country would attribute his pair of brackets to the error of judgment on the part of his parents in making him walk at a tender age. As a matter of fact, it is universally recognized that bow legs on molders are caused by carrying heavy dinner pails to work and by carrying heavy ladles of iron out to the dog house every afternoon. I worked down in Monterey one time and the man next to me had the bandiest pair of legs I ever saw on a human being. They looked like the front supports of a prize bull dog. His mind had a peculiar bend in it too. I went up to his house one night on a visit and he told me of a shop he at one time had charge of in the central west. It appeared that he had made such a success of it that he was regarded as an oracle. His opinion and advice were sought by foundrymen for miles around. A most extraordinary request came to him through the mail one day from a foundryman in a neighboring state. He showed me copies of the question and his reply, and in case it may tax your credulity I can show you a copy of the correspondence which he very kindly forwarded to me some time after I had left there on a tour up the coast."

Bill called to one of his numerous young lady relations and asked her to bring him the book in which the document was folded and put away. She brought it and Bill turned over the leaves until he found the desired paper.

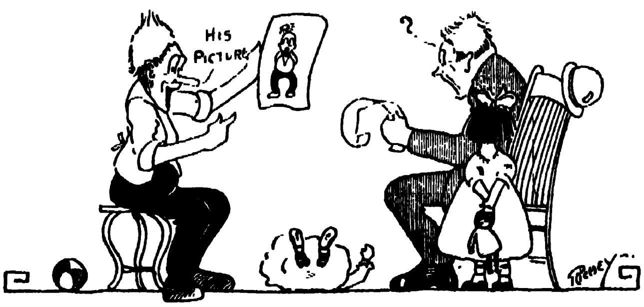
"Here," said he. "Just look over that and see what you think of it.'

It was in the shape of a question and answer and was as follows:

We have been asked to quote on a quantity of king-post castings for submarines. This is a little out of our regular line, which is mining machinery for wild cat mines, and we will appreciate any information you can give us on the most efficient method of molding these castings, also a suitable mixture to pour them.

The answer the bird sent them was both complete and voluminous He said:

Replying to your esteemed communication of recent date we beg to advise that it was extremely fortunate that you thought of consulting us before undertaking such a hazardous enterprise. The contemplated line of castings is one of the most difficult with which foundrymen have to contend.



HE WAS THE ORIGINAL FOUNDRY ORACLE

There is a certain amount of similarity between the proposed work and that in which you are already engaged. Submarines are only seen occasionally and wild-cat mines are never seen. In point of seniority the wild-cat mining industry admittedly is in the lead. It has been in existence since the golden days of '49, while the submarine has only been a recognized factor in industrial life during the past decade.

Wild-cat mining machinery has been brought to a high state of development in this country and some large and complete units have been set up in various rich mining sections of the country, notably New York, Chicago and Boston. The veins in these districts have been worked for years, but the supply of rich auriferous ore seems to be inexhaustible.

We will now consider some of the features necessary to the successful production of king-post castings for submarines. The selection of a grade of sand suitable for castings of this description is of the utmost importance. It should conform to the strictest chemical and physical specifications. The slightest deviation from the accepted standard will play havoc with the completed casting When it is realized that the king-post is the center on which the submarine pivots it will be apparent to any thinking person that the slightest variation in the metal thickness, or in the specific gravity of the iron of which the casting is composed will have an appreciable effect on the boat's evolutions. It also must be borne in mind, that the boat is destined primarily to operate and function under water and that the pressure increases in direct ratio to the depth and therefore the iron must be of a suitable analysis to resist hydrostatic pressure. The corrosive action of sea-water, profanity at close quarters, and the line of conversation handed out by the First Luff also must be taken into consideration. These are points which will be touched upon again when we consider the tests to be employed in selecting a suitable iron mixture for pouring the castings. A grade of light sand should be selected for making the molds. By light sand is meant one which when weighed at ordinary atmospheric pressure and temperature, on a standard beam or platform scale will register approximately 16 ounces to the pound, avoirdupois. If it is desired to prepare a large quantity at one time, say a ton, it will be deemed to come within the limits of this specification if each ton contains 2000 pounds. Sand not measuring up to this specification or exceeding it should invariably be rejected.

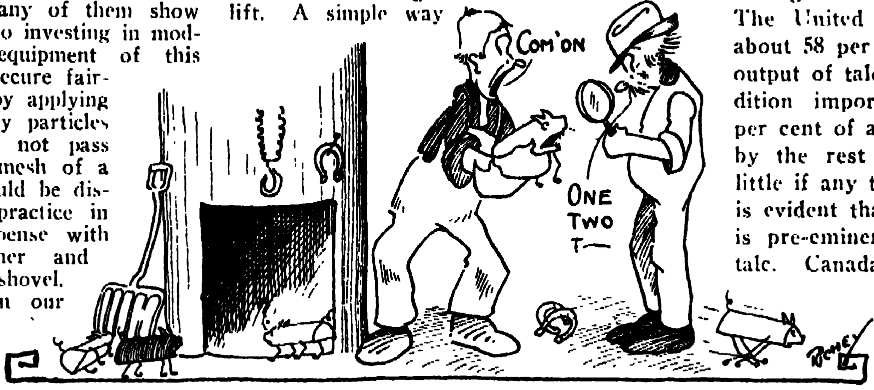
The color of the sand is an important item. Green sand is the most suitable with yellow and black sand as second and third choice in the order named. Alice blue, mauve, heliotrope or vivid shades of vermillion and scarlet are not held in repute by foundrymen of experience. Some time ago the "Society for the Extraction of Square Pegs from Round Holes" recommended that ultra-marine blue sand should be used exclusively on marine work but the measure did not meet with approval. It was held that while the prospects for the American merchant marine did not look blue that was no reason for introducing blue sand into the molding shop. The committee to which the question was referred also reported that blue had a depressing effect on the men's spirits. It is a notorious fact that the output on blue Monday always falls short of that turned out on any other day of the week, due to color effects.

Irrespective of its color, the sand must have a high coefficient of expansion and contraction, which means that it must not be so tight that it will squeak while the rammer is going through it and at the same time it must not be of such an open texture that the molten iron will seep through it during the pouring operation, and run out through the bottom board. A microscopic examination should disclose grains of a uniform size, slightly angular in contour and lying in reasonably close proximity to each other. If the molder has no microscope in his tool bag (and it must be admitted that many of them show a decided antipathy to investing in modern and efficient equipment of this character) he may secure fairly accurate results by applying the riddle test. Any particles of sand that will not pass freely through the mesh of a half inch riddle should be discarded. It is the practice in some places to dispense with the riddle altogether and simply use a fine shovel, but this method, in our opinion, is not sufficiently accurate and should be discouraged. It tends to retard production when the molder has to dig pieces of coke, scrap and sometimes gaggers out of the face of his mold after he has drawn his pattern.

Other characteristics of molding sand which must be taken into consideration are: Elasticity, elongation, reduction in area, and the ability to withstand tortional and compression strains. A sand with a high elastic limit should not be used, for two reasons: First, because it cannot be packed tightly, and, second, because it is a menace to the life and limbs of the operator. A man using a pneumatic rammer on this kind of sand is in danger of having his knee-caps knocked off by the rebound of the rammer.

Elongation also is to be avoided. This feature in molding sand forces the ends of the slip jackets apart and causes distorted castings. Reduction in area also is dangerous. This peculiar characteristic of some sands causes a great many disputes between the molders and the clerk who takes up the heat The clerk counts the number of molds on the floor and credits the molder with, say, 100. The next day there are only 95 castings to be found, a phenomenon which is clearly produced by the excessive reduction in area of the sand. The sand in the molds shrunk 5 per cent between the time the heat was taken up and the time the castings were poured.

The habit which some molders have of attaching chains to their flasks and giving the crane-man the high sign before the chain block is centered over the load has a tendency to place a severe strain on the sand in the mold and it is therefore necessary to provide a sand which will resist this tortional and compression strain. In the event that such a high grade sand is not available, ordinary sand may be used provided suitable precautions are taken to insure a straight lift. A simple way of doing this is as follows: A straight line is projected diagonally across from opposite corners of the flask with the aid of a surveyor's transit or theodolite, and the point where the lines cross is marked with a stake. A perpendicular is erected from this stake using the formula laid down by Q. E. D. Euclid for that purpose. The crane is then summoned and the operator requested to lower his hook and manipulate his bridge and rack until the exact center of the hook coincides with the perpendicular.



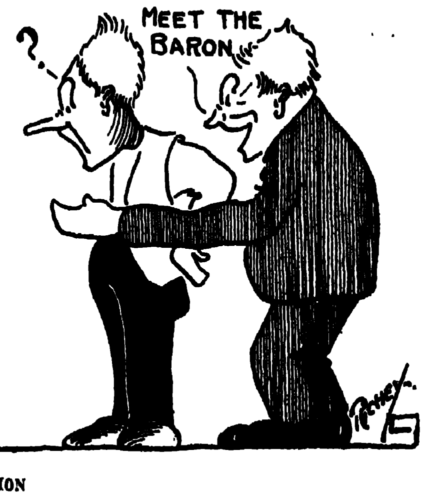
TEETH ARE THE SURE GUIDE TO A PIG'S AGE

The importance of selecting the proper kind of iron for these castings cannot be emphasized too highly. The best iron for the purpose is one that has been made from ore which has been extracted from submarine areas. We should advise the following mixture: 30 per cent old pig; 30 per cent young pig; 30 per cent mixed foreign and domestic scrap, and 10 per cent horseshoes. The old pig furnishes the strength and toughness. The young pig makes the metal run readily. The domestic scrap is used so that the board of directors cannot see a pile of it on their tour of inspection and thereby draw inferences. The foreign scrap is used because of the well known psychological fact that far-away cows have long horns, and the horse shoes, it is unnecessary to point out, are added for luck.

"You must have met some queer people in your time," I said. "I wonder if you ever bumped into the Baron Munchausen?"

"I don't recall any fellow by that name," said he, "but I knew a bird in Birmingham, Alabama, one time—

"Never mind his name," I said. "I have heard all the birdie stories I want to for one night."



ALL THE BARON LACKED WAS BILL'S FOUNDRY EDUCATION

United States Leads in Talc Production

America leads the world in the talc industry, not only in production but especially in manufacture and use. The output of talc in the United States sold in 1918, according to J. S. Diller, of the United States geological survey, department of the interior, was 191,477 short tons, having an average value of $10.91 a ton. The United States produced about 58 per cent of the world's output of talc in 1918 and in addition imported more than 11 per cent of all the talc produced by the rest of the world. As little if any talc was exported, it is evident that the United States is pre-eminently a consumer of talc. Canada is the only competitor for the domestic trade in middle-grade talc. About 12,000 tons, 96 per cent of the talc imported in 1918, came into the United States from Canada.

The United States is well supplied with low and middle grade talc but lacks high-grade material, which is imported mainly from Italy and France and through other countries from India.

Within the last two years a new and interesting source of talc has been found in Harford county, Md.

The Buckeye Casting Company, Lima, Ohio, is installing new equipment to increase its capacity to 400 tons a month. The new equipment includes a No. 3 Whiting cupola, compressor for elevator, air tools, sand blast, tumbling barrels, molding machines, etc. John Sonnenfeld is president, with Carl B. Limbert as vice president and Lou P. Stephens as secretary and treasurer. A steel foundry with electric furnaces is under contemplation.

THE FOUNDRY

A semimonthly journal devoted to all branches of the foundry trade

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Contents

Cupolas Deserve Attention

THE cupola is a comparatively simple melting medium and one soon learns to operate it in a fashion, getting results which are accepted generally as satisfactory. One of the requirements of the foreman of the cupola department is to handle laborers, and this frequently is the main consideration in picking the man to have charge of the cupola. Of course it is important that a man in such a position should be able to handle labor, but he also should have enough education to be able to appreciate the points necessary to operate the cupola efficiently. If a foreman cannot be found who has both practical knowledge of melting and the ability to handle men it is advisable to secure two men and place one in direct charge of the laborers and let the other supervise charging and watch the iron as it is tapped and poured. The latter should have at least a high school education and should receive instructions from the company's metallurgist, so that he will know the reasons for the different reactions in the cupola and what causes different effects in the metal. Such a man will be of little service at first, but in a short time he will show a savings for his employer. Trained intelligence used about the cupola soon will improve the charging and melting practice in most plants. Some large companies which have several foundries adopt the plan of employing high school graduates to supervise the cupolas and the head metallurgist issues bulletins that direct them in their work, instruct them concerning details of operation and point out the meaning of different results.

Castings Indispensable

PRACTICALLY all modern human activity is based upon the products of metal working plants. This statement may be passed as trite through frequent repetition, but it is doubtful if its full truth is realized even by those who are engaged in the foundry, forge or machine shop. In Belgium and portions of France much of the territory occupied by the invading German was reduced to a state bordering on the primeval. Factories were stripped, homes leveled and even the productive soil was swept bare of all which represents the life and activity of man. Repatriation in many regions meant a building up from bare foundations, and a creation out of elemental materials. The inhabitants had been scattered widely through the years of war, and many, blown by the wind of chance, had taken root elsewhere and were not attracted by the bleak prospect of returning to the devasted area. It is significant of the fundamental necessity of foundry products, that in many cases casting plants were the first to be rehabilitated. Homes, factories, transportation equipment, tools, machinery and agricultural implements, all urgently needed foundry products. Even before those who had been exiled began to find their way back again to that portion of the country which had been home, work was actively under way to rebuild, equip and provide materials for the foundries of northern France and Belgium. A most interesting account of the re-establishment of one large industrial concern is presented in the first article of this issue. The restoration of this plant is typical of many throughout the occupied territory.

Trade Outlook in the Foundry Industry

DEMAND for castings which has steadily increased during the past few months now has become acute. Manufacturers driven by urgent and immediate needs are writing inquiries broadcast or sending agents to foundries remote from their territory in the endeavor to secure enough castings to keep their plants in operation. This situation is most marked in gray-iron and malleable lines. The approach of spring has brought an unprecedented flood of construction work, which the public insists upon in entire disregard of the peak prices asked for all classes of building materials. Manufacturers of plumbing and heating supplies are overwhelmed with orders. One large maker of bathroom and heating equipment has advance orders for over 200,000 bath tubs, which will tax the capacity of the company's several plants for the entire year. Automobile manufacturers instead of canceling contracts for castings, a procedure which was predicted by some foundrymen in the early winter, are doubling their orders where possible and seeking untried sources for practically all grades of castings used in making trucks, passenger cars and tractors. Agricultural implement makers are experiencing an unprecedented activity and state that this marks the opening of the largest year ever known in the manufacture of all kinds of farm machinery. Those who supply castings for what might be termed luxuries or more correctly nonessentials are unable to take up any of the overflow demand from other lines. Makers of piano plate, builders of soda fountain equipment and manufacturers of confectioners' machinery are seeking additional foundry capacity to make urgently needed castings.

Prices of Raw Materials for Foundry Use

CORRECTED TO FEB. 23

Iron		Scrap	
No. 2 foundry, Valley	$42.00 to 43.00	Heavy melting steel, Valley	$27.00 to 27.25
No. 2 foundry, Birmingham	40.00 to 41.00	Heavy melting steel, Pittsburgh	28.50 to 29.00
No. 2 foundry, Chicago	40.00 to 42.00	Heavy melting steel, Chicago	24.50 to 25.00
No. 2 foundry, Philadelphia	43.60 to 44.60	Stove plate, Chicago	35.50 to 36.00
Basic, Valley	43.00 to 44.00	No. 1 cast, Chicago	42.00 to 42.50
Malleable, Chicago	43.50	No. 1 cast, Philadelphia	29.00 to 40.00
Malleable, Buffalo	41.25 to 42.25	No. 1 cast, Birmingham	33.00 to 35.00
Coke		Car wheels, iron, Pittsburgh	44.00 to 45.00
Connellsville foundry coke	$7.00	Car wheels, iron, Chicago	37.50 to 38.00
Wise county foundry coke	8.25	Railroad malleable, Chicago	33.50 to 34.00
		Agricultural malleable, Chicago	33.50 to 34.00

New Users of Castings

The marked increase in different makes of small motors, washing machines and other household machinery has brought a new class of small castings users into the market at a time when it is most difficult to find foundries which can supply the needed parts. With all this rush of business a marked extension in the entire foundry industry is in full swing. The abnormal demand has been accentuated by shortage and nonproductiveness of labor to a degree which threatens an over expansion. It is commonly understood that when a manufacturer places an order for a great number of castings upon which he can receive no assurance of time of delivery and little guarantee of price, he duplicates his order with a number of foundries. Then when his requirements are covered by the delivery of his order from one firm, he at once will cancel the pending orders with other foundries. There is a basis for the opinion held by some foundrymen that the present demand is inflated and that the rapid expansion of foundry facilities may eventually result in a general slackening off with the attendant reaction comparable to overproduction.

Rail Buying Expected

With the return of the railroads to private ownership, the long expected buying of equipment seems imminent. This will have a marked effect, both on those foundries which specialize on railway work and also indirectly upon others, through the withdrawal of some, notably malleable shops from the manufacture of miscellaneous castings to concentrate on railroad work. It is stated that a plan is nearing completion which will permit the early purchase of 2000 locomotives and about 100,000 freight cars to be allocated among the different railway lines. The roads have been gathering their own equipment, making lists of requirements and otherwise preparing to be early in the field in the rush for supplies which is expected to follow the return to private control. Car-wheel shops which for the past two years have been almost entirely inactive except for repair and replacement work, anticipate a heavy demand. The shortage due to meager replacements during the war, has been brought sharply to focus by the tremendous rush of business and attendant pressure on transportation agencies during the past few months. It is stated that the railroads normally require about 100,000 new freight cars every year to replace those which wear out in service. This figure is derived from the following table showing the purchase of cars by the railroads during the five years preceding the war:

	Added	Retired
1913	102,070	96,825
1914	150,813	96,985
1915	86,012	90,347
1916	88,254	109,966
1917	117,208	*62,250
Total	604 857	456,408
Average	120,991	91,284
Net addition yearly	29,700	.....

*Estimated

Less Call For Iron

A slackening is noted in the demand for foundry iron. By some this is attributed to the realization of the lack of iron for early delivery and the wish to avoid bulling a market which already is considered too high. The slight recession in scrap prices is the result of a common agreement to disagree between the dealers and foundrymen. The latter feel that scrap prices are beyond reason. New York quotations on nonferrous metals follow: Copper, 18.25c; lead, 9.12½c; tin, 61.20c; antimony, 11.75c to 12.00c; aluminum, No. 12 alloy, producers' price, 31.50c and open market, 30.00c to 31.50c; zinc is 9.00c St. Louis.

Comings and Goings of Foundrymen

Charles A. Dreisbach, formerly president and manager of the New Haven Sand Blast Co., and Charles S. Johnson, formerly western representative of the same company, now are associated with the Standard Equipment Co., New Haven, Conn., manufacturer of cinder mills, ore crushers and pulverizers. The Standard Equipment Co. soon will enter upon the manufacture of a line of foundry equipment.

William Bragg has been made foundry foreman for the H Wetter Mfg Co., South Pittsburgh, Tenn.

Charles A. Bieder has been appointed assistant manager of sales in the railway department of the National Malleable Castings, Co., Cleveland

L. D. Kluver has been placed in charge of the newly established Detroit office of White & Bro., Inc., Philadelphia producers of nonferrous alloy metals.

John D. Green, secretary of the Detroit Stove Works, Detroit, has resigned to become vice president and general manager of the Rathbone-Sard Co., Chicago, stove manufacturer.

B. L. Weaver has resigned his position as steel foundry superintendent for the Vulcan Iron Works, Wilkes-Barre, Pa., to become associated with the Philadelphia Roll & Machine Co. plant of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

F. J. Ryan was elected president of the Metallurgical Corp., Philadelphia, at the recent annual meeting. Other officers of the company are S. R. Vanderbeck, vice president; W. L. Taylor, treasurer; J. L. Hawley, assistant treasurer, and S. H. Ourbacker, secretary.

K. B. Thorndike has been appointed sales engineer in charge of the New York office of the Phoenix Iron Works Co., Meadville, Pa. A new Boston office has been established by the same company with Paul C. Rogers in charge.

T. A. Martin recently has severed his connection with the George H. Smith Steel Castings Co., Milwaukee, and now is in charge of the installation of a new steel foundry for the Erie Forge Co., Erie, Pa.

William R. Gummere, who for a number of years was associated with the Independent Pneumatic Tool Co., Chicago, again has joined that company and will be connected with the Pittsburgh branch office.

Paul V. Faragher, formerly connected with the Mellon institute at Pittsburgh, has accepted a position in the research laboratory of the Aluminum Steel Co. of America, New Kensington, Pa.

John H Rose has been appointed sales engineer of the Aetna Foundry & Machine Co., Warren, O. Mr. Rose since 1912 has been associated with the Youngstown Sheet & Tube Co. in the engineering department.

H. P. Wingert, formerly general purchasing agent for the American Brake Shoe & Foundry Co., now is president of the American Commodities Corp., organized to handle pig iron, coke, coal, iron and steel products, and scrap. The offices of the new company are at 30 Church street, New York.

D. C. Jones, Lunkenheimer Co., was elected president of the Associated Foundries of Cincinnati at a recent meeting. The other officers chosen were Neil C. Lamont, Worthington Pump & Machinery Corp., vice president; George F. Dana, Peerless Foundry, secretary, and H. A. Lammers, Cincinnati Steel Castings Co., treasurer.

W. E. Troutman, president, and R. W. Tener, treasurer of the Braddock Mfg Co., Braddock, Pa., retired recently coincident with the sale of that company's plant to the Wilson-Snyder Mfg. Co., Pittsburgh. F. C. Sullivan, vice president and engineer, also retired on March 1, while H. L. Campbell and F. B. McConnell, other officers of the company remain with the new owners. The Wilson Snyder Co. manufactures pumps and equipment.

M. F. Gartland was elected first vice president of the Dayton Malleable Iron Co., Dayton, O., at its recent reorganization meeting, which re-elected J. C. Haswell president. Mr. Haswell closed his annual report with a tribute to the late Samuel W. Davies, who was connected with the company for more than 30 years, recently as vice president. Other officers elected at the meeting are: Vice president in charge of sales, H. D. Hunter; vice president in charge of operation, W. B. Runyan; secretary, W. H. Cassel; treasurer, Adolph Heinz.

Col. John Roper Wright has received a baronetcy at the hands of the king of England. Most of his achievements have been in connection with the steel trade, largely in South Wales. He commenced his career in Soho Foundry, Preston, and as a young man on the staff of the late Sir William Siemens carried out all of the experiments for the manufacture of open-hearth steel by the Siemens-Martin process. Subsequently he went to Swansea and developed the process commercially. After being associated with several steel companies an amalgamation was effected in 1894 of E. P. & W. Baldwin of Stourport, Wright, Butler & Co., Alfred Baldwin & Co., and the Blackwall Galvanizing Co. into Baldwin's, Ltd. Since 1908 Colonel Wright has been chairman of the latter company having succeeded the late Alfred Baldwin. Colonel Wright is a director of several other companies.

Traces History of Iron

Dr John G. Unger, head of the bureau of research of the United States Steel Corp., was the chief speaker of the regular monthly meeting of the Pittsburgh Foundrymen's association. Dr. Unger substituted for Louis E. Endsley, professor of mechanical engineering, University of Pittsburgh, who was to have been the principal speaker, but who was unable to be present on account of illness.

The speaker claimed that the discovery of iron outdated that of either gold or silver, asserting that authority existed for the belief that Enoch, son of Cain and grandson of Adam, actually discovered iron in the ashes of the smoldering camp fires along the banks of the Euphrates river. Dr. Unger traced the history of iron, both from a geological and chemical standpoint, and ventured the prediction that not only would the country soon be using ore of much lower metallic content than that now used, but that within 100 years, iron would be supplanted by some alloy derived from clay, containing iron, silica and alumina, which he said would be a third the weight of iron and possess higher physical properties than iron.

Montfort Jones, professor of economics, University of Pittsburgh, gave a talk on the foreign exchange situation, in which he pointed out the dangers to foreign trade unless the present rates were soon adjusted and also the possibility of the reshipment of American products to this country because of the big premium which the American dollar now commands in international exchange.

New Truck For Foundries

A new gasoline truck for hauling castings, cores, molds, sand, and other burdens up to 2500 pounds weight has been placed on the market by the Clark Tructractor Co., Chicago, Ill. This machine is designed to operate inside the plant buildings as well as outdoors, at speeds varying from ½ to 12 miles per hour. It is narrow in construction and so will run in aisles and within a very limited operating space. It acts as both a truck and tractor. Foundries use this machine in the core room, stock rooms, sand piles and for general plant haulage. Bodies of various types are furnished for carrying the load. All bodies will carry a 1¼-ton load and cargo bodies have a capacity of one cubic yard of bulk materials such as sand, etc. A truck unloading sand is shown in the accompanying illustration. The machine is run on three wheels, and is steered from the rear by a single wheel. The load is carried over the two front driving wheels. The driver's seat is over the engine facing the load. The four-cylinder engine is carried above the single rear wheel.

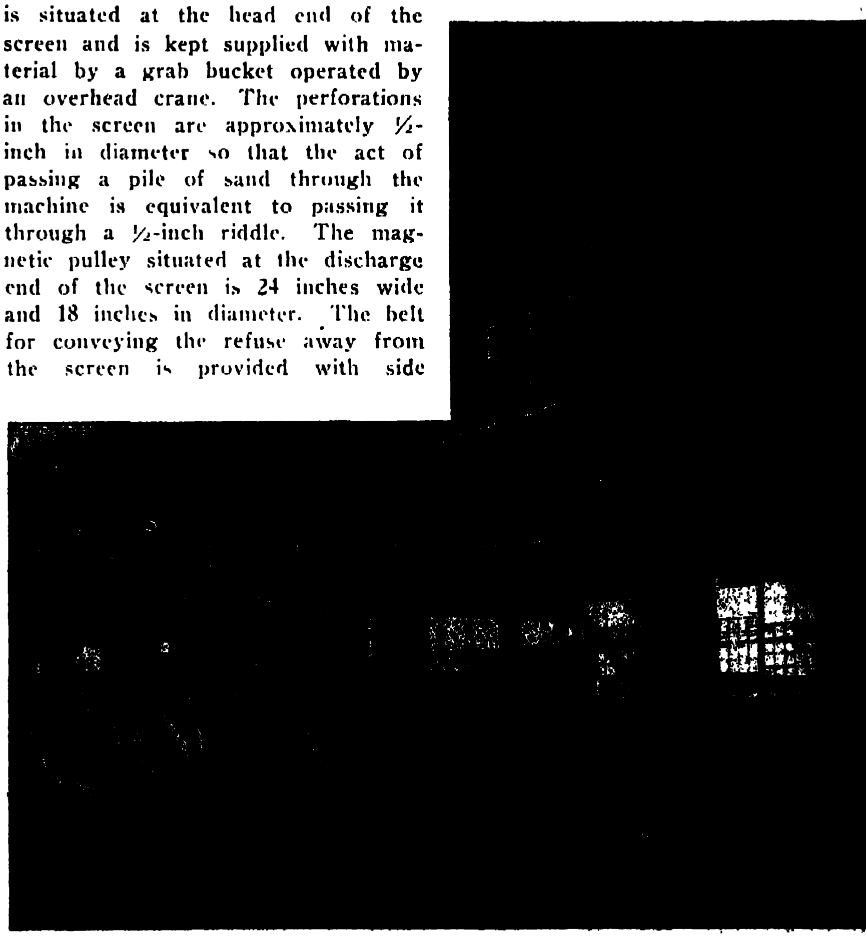
NEW TYPE COMBINED TRACTOR AND TRUCK FOR FOUNDRIES

Combined Sand Mixer and Magnetic Separator

An installation, designed and built by the Dings Magnetic Separator Co., Milwaukee, is shown in the accompanying illustration. The equipment which includes a sand mixing and riddling system with a magnetic separator, is strong and ruggedly constructed. It is mounted on a platform at a sufficient height from the floor to allow the screened sand to be piled at a point on the floor from which it can be removed by barrow or grab bucket. The box or other receptacle for catching the refuse is also located on the floor level. It usually is provided with handles by which it can be lifted by the crane and conveyed to a car or truck employed for transporting that kind of material to the dump.

By referring to the illustration it will be noted that the complete machine consists of a feed hopper, a large revolving screen and a magnetic pulley with suitable motor, pulleys and belting to drive it. The feed hopper which has a capacity of 3 or 4 yards is situated at the head end of the screen and is kept supplied with material by a grab bucket operated by an overhead crane. The perforations in the screen are approximately ½-inch in diameter so that the act of passing a pile of sand through the machine is equivalent to passing it through a ½-inch riddle. The magnetic pulley situated at the discharge end of the screen is 24 inches wide and 18 inches in diameter. The belt for conveying the refuse away from the screen is provided with side boards and deflection boards to prevent any of this material from falling upon the lower belt which is shown in the illustration.

Under the ordinary system of cutting over sand either by hand or mechanically, none of the foreign material is removed unless it happens to be quite large and cannot be ignored. It is claimed for the magnetic separator that it screens all of the sand and leaves it in condition for molding purposes; that it eliminates all the coarser material and while this latter is passing over the magnetic pulley it reclaims all the iron which may have found its way into the sand during the day. Clamps, gaggers wire, rods, slings, chills, small castings, pieces of scrap are all salvaged while the burned cores, brick bats, etc., are discharged into an iron box for final disposition on the dump.



CONTINUOUS RIDDLING AND SEPARATOR PLANT OF LARGE CAPACITY

Make Ladle Nozzles in the Core Room

(*Concluded from page* 199)

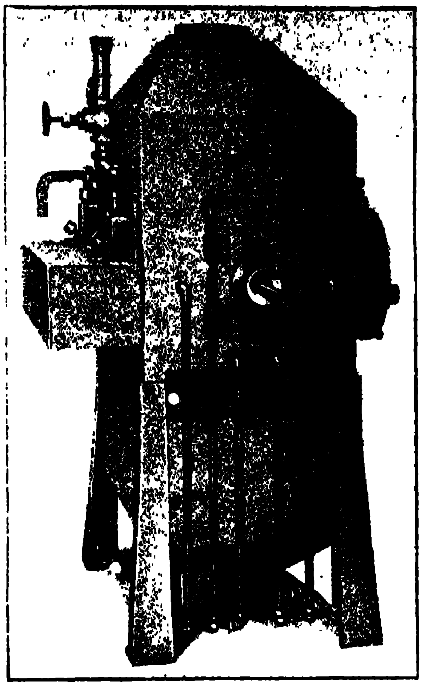
A is fastened to the rod in the usual way, as shown at *B*. Two burnt fireclay sleeves are then put on the rod and the whole covered with a fireclay wash after a nut has been screwed on the other end of the rod with a

collar between it and the clay sleeves. The hole in the end of the stopper is plugged with fireclay.

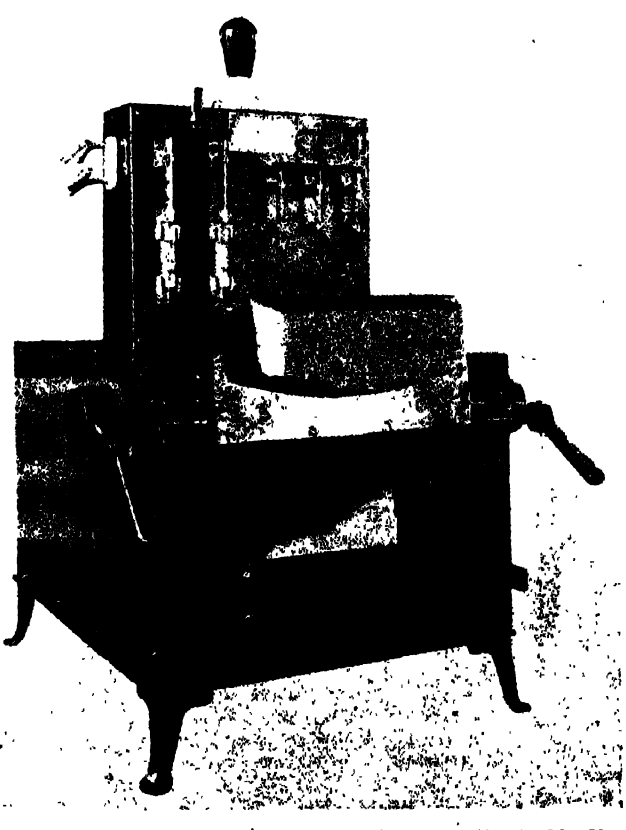
The nozzle, which is the special feature of this combination is made in the core room on a squeezer machine It is formed of fireclay mixed with a small amount of sand. The nozzle is baked at the same temperature as cores, and so is not as strong as if it were burned at a higher temperature as are the nozzles sold for the trade in general. This nozzle is reinforced with a cast-iron ring, one of which is shown at C in the illustration on page 199. The nozzle, shown at D, gives a view of the side to be supported by the cast-iron ring. In the center of the illustration the mold for casting the rings is shown. This is made of cast iron and many rings can be cast in a short time as the metal sets almost immediately and the mold then may be emptied and made ready for another casting. Underneath the mold may be seen one of the rings and a pile of metal which has dripped off the mold from time to time as it was poured.

New Electric Heat-Treating Muffle Furnace

An electric furnace of the muffle type for baking vitreous enamel, hardening and tempering tools at temperatures up to 850 degrees Cent., has been developed by the General Electric Co., Schenectady. It consists of a furnace chamber with a control panel provided at the front. The heating element which is mounted on the outside of the muffle and covered with insulating compound is placed so as to give an even distribution of heat throughout the inside. The heating device is divided so that it is possible to get two gradations of temperature, which for convenience are known as high and low heat. The former is used to give a high initial heat, so that the maximum temperature may be reached quickly. In ordinary operation this maximum is reached in 1¼ hours after which the low heat is sunfficient to maintain an even temperature. The muffle is mounted in a strong steel casing and the walls, top, bottom and door, are thoroughly insulated, thus decreasing the loss of heat through radiation. The control panel is equipped with a main line switch, a double throw switch for high and low heat, and a red pilot lamp which acts as a warning to the operator when the furnace is on high heat Connections on the side of the panel are provided to connect rheostats when temperatures as low as 300 degrees Cent. are desired. These features permit an adequate control of the temperature. The pilot lamp is installed to prevent destruction of material due to carelessness, or inability on the part of the operator to estimate what temperature is being carried. The furnace is provided with a shelf in front and the door is balanced by counterweights to keep it open. When on high heat, the furnace requires 4 kilowatts to bring it up to 850 degrees Cent.



SMALL SAND BLAST CABINET FOR RODS



ELECTRIC FURNACE HAS RANGE OF TEMPERATURE FROM 300 TO 850 DEGREES CENT

Cabinet Type Sand-Blast for Cleaning Rods

A cabinet equipment recently produced by the Pangborn Corp., Hagerstown, Md., and shown in the accompanying illustration is devised to sand blast various shaped rods from ⅛ to ⅞-inch in diameter. The device embodies novel features of continuous operation with hygienic construction for the protection of the operator. The blasting chamber is entirely enclosed, and therefore the machine may be operated in the vicinity of machine tools without danger of damage from flying dust and abrasives. A set of rolls and guides at each end of the cabinet drives the rods at a uniform rate of speed through the blasting zone. The feed rolls are shaped to handle rods of any shape and diameter from ⅛ to ⅞ inch. The stream of abrasive enters the blast chamber through six projectors centering to the rod at a 45 degree angle and acting on the entire surface. The discharge is directed toward or into a small chamber that utilizes the rebound effectiveness of the abrasive. It is stated that scale has been removed from ¾-inch diameter rod with 80 pounds air pressure at a speed of 50 linear feet per minute. The bottom of the cabinet forms a hopper for storing the abrasive. The blast action is the suction type and individual feedboxes, in plain sight of the operator, supply each blast nozzle. Connection to an exhaust system removes disintegrated material. The cabinet is adapted for use with either sand or metal abrasive. It stands 69 inches high and occupies a floor space of 45 x 51 inches.

The P. H. & F. M. Roots Co., Connersville, Ind., manufacturer of blowers, contemplates selling its present foundry with all equipment.

Nickel Found in Alaska

Nickel minerals have geen found at various localities in Alaska, but none of the deposits has yet been worked. One group of these deposits is described in a recent publication of the U. S. geological survey, department of the interior, entitled "Nickel Deposits in the Lower Copper River Valley, Alaska," by R. M. Overbeck. The ore minerals are sulphides which have been altered by weathering. A selected specimen of this sulphide ore analyzed in the survey laboratory showed 7.23 per cent nickel. A number of rusty croppings on Canyon creek have been staked and assays are reported to show a small percentage of nickel. A specimen of sulphide ore from one of these croppings showed a minute trace of nickel when tested. The extent and probable value of these deposits could be determined only by careful sampling and by some development work below the partly oxidized surface cropping.

Moves to Philadelphia

The T. W. Price Engineering Co., designers and constructors of steel plants and foundries, has moved its main office from the Woolworth building, New York, to Philadelphia, and its drafting room to New Brunswick, N. J. Until the necessary accommodations in Philadelphia can be obtained, the main office of the company temporarily will be located in New Brunswick. The company will maintain New York small sales offices.

Purchases New Furnace

The Standard Brake Shoe & Foundry Co., Pine Bluff, Ark., has purchased a 1½-ton electric furnace from the Greene Electric Furnace Co., Seattle, and will install it with other equipment in a new steel and concrete building now under construction. The new furnace will be used to supply steel for a new type cast-steel plate back for locomotive-driver brake shoes, and also for general steel jobbing work.

The Westerly Brass Co., Westerly, R. I., recently has incorporated under the laws of Rhode Island and plans extensive plant changes and additions which will include compressors and electrical equipment.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Rock Island Mfg. Co., Rock Island, Ill., is building an addition to its foundry, 80 x 120 feet.

Plans are being drawn for the erection of a plant for the Cooper Brass Works, Ogdensburg, N. Y.

The Southern Stove Works, Inc., Richmond, Va., is reported planning the erection of a stove foundry.

The Cameron Stove Co., Richmond, Va., has under consideration the erection of a foundry.

Capitalized at $50,000, the Peru Brass & Mfg. Co., Peru, Ind., recently was incorporated by Ernest Theobald, Oscar Theobald and John T. Knott.

Fire recently damaged the plant of the Alliance Brass & Bronze Co., Alliance, O. The pattern room and offices escaped damage.

Waldron & Van Winkle, New York, industrial engineers, will take bids shortly for the erection of a 100 x 500-foot foundry for the Windsor Foundry Co., Windsor, Vt.

The Magnetic Mfg. Co., Milwaukee, manufacturer of separators for foundries and smelters, is building a plant, 60 x 120 feet.

The Enterprise Foundry Co., Charles Crowlin, 1127 Griswold avenue, Detroit, contemplates the erection of a cupola building, 35 x 40 feet.

The Standard Steel Casting Co., 910 South Michigan avenue, Chicago, contemplates the erection of two buildings, each 70 x 250 feet.

The National Bronze & Aluminum Foundry Co., 2639 East Seventy-ninth street, Cleveland, is reported planning the erection of a plant addition.

Einar Owren, Charles M. Robbins and W. A. Briggs are the incorporators of the Owren Casting Co., Attleboro, Mass., which was recently chartered with $10,000 capital.

Capitalized at $25,000, the Danbury Foundry Co., Inc., Danbury, Conn., recently was chartered by R. J. Hansin, E. Hansin and W. H. Cable.

The Rome Brass & Copper Co., Rome, N. Y., is reported planning to make alterations to its office building.

O. Z. Vannoy was named among the incorporators of the Economy Stove Co., Greenville, O., which was recently incorporated with $75,000 capital.

The O. K. Stove & Range Co., Louisville, Ky., plans the erection of plant additions, including a foundry.

Plans are being prepared for the erection of an addition to the foundry and pattern shops of the Pomona Mfg. Co., Pomona, Cal.

Erection of a machine shop and foundry, is reported being planned by the Baltimore Valve Co., Baltimore.

The Barnett Foundry & Machine Co., Lyons avenue, Irvington, N. J., has had plans prepared for the erection of an addition to its plant.

Robert Perlick, brass founder, 194 Reed street, Milwaukee, has incorporated under the style, R. Perlick Brass Co., with a capital of $15,000.

The Kewanee Boiler Co., Kewanee, Ill., is building several additions to its plant. They are additions to the boiler shop and foundry.

The W. M. Crane Co., Garfield avenue, Jersey City, N. J., manufacturer of stoves has awarded a contract for the erection of a plant to include a foundry.

The James T Clark Co., 70 Adams street, Newark, N. J., contemplates the erection of an addition to its foundry.

The J. C. Eichman Mfg. Co., Bish and Wicomico streets, Baltimore, is planning the erection of an addition to its foundry, 40 x 40 feet.

Contracts for the erection of a foundry building, 65 x 400 feet, an administration building, 50 x 90 feet, a power house and a crusher plant, have been let by the Simbroco Stone Co., Boston.

The plant of the Bridgeport Castings Co., Bridgeport, Conn., which was recently damaged by fire, will be rebuilt at once. The new structure will cover 22,000 square feet.

The P. B. Yates Machine Co., Beloit, Wis., will start construction of a gray-iron foundry, 208 x 264 feet, and also will undertake enlargement of its machine shops.

An addition to its gray-iron foundry, 220 x 300 feet, is being erected by the Kohler Co., Kohler, Wis. An engineering building, 130 x 262 feet, is also being built.

Capitalized at $10,000, the Schmitt Brass Foundry Co., Columbus, O., recently was chartered by G. W. Schmitt, Ed. Schmitt, S. F. Deardof, G. M. Schmitt and C. V. Dehnoof.

Erection of an addition to the foundry of the Gisholt Machine Co., Madison, Wis., is expected to be started shortly. The building will be 113 x 300 feet.

Plans are being prepared by the Lakey Foundry Co., Muskegon, Mich., a branch of the Continental Motors Corp., for the erection of an addition to its foundry, which will practically double the capacity of the plant.

The Northwest Foundries, Inc., Villa and Valentine streets, Rochester, N. Y., has had plans prepared for the erection of a gray-iron foundry, 197 x 250 feet. George A. Hetzler is secretary and general manager.

Plans are being prepared for the erection of an addition to the plant of the O. B. North Co., New Haven, Conn., manufacturer of castings. The building will be 37 x 110 feet.

Maldsof & Ashton, Troy, N. Y., have been incorporated to engage in the manufacture of iron and steel castings with $15,000 capital, by H. M. Ashton, J. E. McNary and J. L. Maldsof.

The Pattern Foundry & Equipment Corp., New York, has been incorporated with $10,000 capital, by S. H. Selig, J. Sachs and A. L. Ross, 665 West 160th street.

Capitalized at $500,000, the Lima Foundry & Machine Co., Lima, O., recently was incorporated under the laws of Delaware, by T. L. Croteau, C. H. Blaske and S. E. Dill of Wilmington, Del.

The Albrass Co., Albany, N. Y., recently was incorporated with $25,000 capital, to engage in foundry work, by E. W. Leahy, J. Erickson and F. A. W. Griesau.

W. J. Hickey, 119 Main street, Welland, Ont., has been awarded the contract to rebuild the plant of the Welland Iron & Brass Co., which was recently damaged by fire.

The Hoffman Heater Co., Lorain, O., which recently completed the erection of a new plant, is reported considering the erection of a foundry addition to its plant, within the year.

H. Kramer & Co., Inc., 1224 West Twenty-first street, Chicago, is building a foundry, 127 x 200 feet, a warehouse, 30 x 85 feet, and an office building, 58 x 65 feet.

The Erie Rubber Mold & Machine Co., Sandusky, O., recently was incorporated by A. E. Rogers, A. J. Jeisa and others, and will establish a plant. The company is capitalized at $10,000.

The Sully Brass Foundry, Ltd., Toronto, Ont., recently was incorporated with $40,000 capital, by

George H. Sedgewick, John W. Pickup and James Atchison.

The Cook-Lewis Foundry Co., Greensboro, N. C., brass products, recently was incorporated with $50,000 capital, and plans are being prepared for the erection of a plant, 40 x 75 feet.

The Independent Brass Works, Center and Walnut streets, Louisville, Ky., has closed a contract for the erection of a building to increase its foundry space.

The Mont-Clare Foundry Co., Philadelphia, recently was incorporated with $50,000 capital, by Clare M. Borton, 114 Park Row, Horace E. Frick, 806 South Forty-ninth street, and Randolph Sailer, 920 Chestnut street.

Local capital at Milwaukee is organizing the American Foundry Co., which will be incorporated with $100,000 capital. It is reported plans are being prepared for the erection of a gray-iron foundry for the production of light castings.

The Buckeye Brass & Mfg. Co., Harry Selker, president, 6410 Hawthorne avenue, Cleveland, is having plans drawn for the erection of a furnace room and foundry, 30 x 110 feet and 75 x 75 feet respectively.

Announcement has been made that the Battle Creek Jobbing Foundry, Battle Creek, Mich., which was formerly located at Galesburg, Mich., plans to enlarge its foundry and install a cupola to melt 12 tons per hour.

The Columbia Sanitary Mfg. Co., Louisville, Ky., manufacturer of bathtubs, plumbing goods, etc., has tripled its stock to $300,000, and has announced plans for doubling the capacity of its foundry and the other departments of its plant.

The Illinois Malleable Iron Co., which purchased a 43-acre site at Louisville, Ky., has not done anything with the property as yet, but is reported planning to go ahead with the erection of a large plant in the spring.

The South Side Malleable Castings Co., Fourteenth and Windlake streets, Milwaukee, is making improvements to its plant. The most important items of new equipment to be installed are three 5-ton charging cranes, and a craneway over the furnaces.

The Valley Iron Works, Appleton, Wis., which doubled the size of its foundry and machine shop during the war, is erecting further additions which will increase its capacity about 50 per cent. Some contracts for additional foundry and machine shop equipment are being placed.

Formation of the Gartland Haswell-Rentschler Foundry Co., at Dayton, O., has been announced. The company will take over the complete foundry organization of the Platt Iron Co., according to reports from Dayton. Gordon S. Rentschler is head of the new firm.

The Olympia Foundry Co., Olympia, Wash., recently was incorporated by W. L. Phillips, William Allard and others. The company for the present will engage in the manufacture of gray iron castings, but plans to later on add the manufacture of brass castings to its line.

The Machinery & Foundries, Ltd., Brockville, Ont., has been incorporated to carry on business as iron founders, steel makers, etc., with $250,000 capital. The company will start work in the spring on the erection of a foundry. Directors of the company are: James C. Gardner, George E. Purkis, Joseph R. A. Laing and others.

Contract has been awarded for the erection of a foundry for Williams, White & Co., Moline, Ill. The building will be 150 x 325 feet, with a covered material bay, 400 feet long. The Clement A. Hardy Co., Chicago, is acting as consulting engineer on the project, and has purchased the necessary structural steel.

The Rabe Pipe & Foundry Co. has been organized at Chattanooga, Tenn., with a capital of $200,000, to engage in the manufacture of soil pipe and plumbing supplies. Incorporators are former County Judge Will Cummings, R. R. Rabe, Clifford Fryar, W. H. Cheney and T. Pope Shepard. Work on the erection of a new plant will be started at once. It will employ about 150 men.

The New Process Copper Castings Co. recently was incorporated under the laws of Delaware with a capital of $100,000, by John Mellor, president; James Smith, vice president and general manager, and John C. Bramer, secretary-treasurer. The company will engage in the manufacture of bronze and copper castings, specializing in castings for blast furnace equipments.

The J. I. Case Plow Works Co., Racine, Wis. is erecting two foundries and a warehouse as additions to its plant. The gray-iron foundry is 120 x 360 feet, the malleable plant, 150 x 300 feet and the warehouse, 122 x 140 feet. This work is in charge of Foltz & Brand, Conway building, Chicago, architects and engineers. C. D. Bidwell is engineer in charge of maintenance for the company.

The National Farming Machinery, Ltd., Montmagny, Que., which recently acquired the plant of the General Car & Machinery Works, will build extensions to the plant and install new equipment. The company will continue the manufacture of steam engines and boilers, sawmill and woodworking machinery. It will also operate steel, iron, brass and aluminum foundries. A small rolling mill is among the improvements.

The Alloy Electric Steel Casting Co., which was recently incorporated at Columbus, O., with $300,000, plans to erect a plant at Warren, O., for the manufacture of automobile parts and general castings. The plant will be equipped with several electric furnaces. The first building of the proposed plant will be 110 x 200 feet, and construction will be started about April 1. Jacob Coxey, Massillon, O., and his two sons, H. L. and J. S. Jr., are behind the project.

Contractors have started on the erection of a foundry, to be devoted exclusively to the manufacture of high grade light and medium weight commercial gray-iron castings for the Advance Castings Co., Goshen, Ind. The first unit consists of a molding room, 70 x 190 feet, with core room, cupola room, blower room and pattern storage room adjoining the main foundry. The company recently was incorporated with $50,000 capital. S. E. Schlicht is president and treasurer of the company.

The Shawinigan Foundries, Ltd., Shawinigan Falls, Que., has acquired the electric furnace plant of Fraser Brace & Co., as well as the iron foundry formerly operated by Normandin Bros. Additions to the plant are under contemplation, and arrangements are being made for carrying on a brass foundry work and putting a special grade of semisteel castings on the market. G. G. McCartney is president of the company; W. G. Dauncey, vice president, and C. M. Hall, secretary.

Erection of a gray-iron foundry, 100 x 100 feet, as an extension to the plant of the Dominion Steel Products Co., Ltd., Brantford, Ont., has been started. The foundry will be equipped with the most modern foundry equipment, including a 20-ton air furnace and two cupolas. It is expected the plant will be ready for occupation some time in March. The output of this plant will consist of a general line of castings; rolling mill equipment, rolls, rubber working machinery, rubber mill and calender rolls, and cores and molds.

Ira L. Houghton, Toledo, O., formerly president and general manager of the Maumee Malleable Castings Co., Toledo, O., has organized the Houghton Malleable Castings Co., with an authorized capital of $500,000, and will locate in Toledo on a 25-acre tract. The construction of the first plant unit will be started early in March. This building, which will cover about 150,000 square feet of floor space, will house three 35-ton air furnaces, core and annealing ovens. The buildings will be of steel and glass construction, and contracts for new equipment will be let shortly. The office of the company is at 965-966 Spitzer building, Toledo.

New Trade Publications

INDUSTRIAL PIPING.—A booklet, entitled "Inter-Related Industries," is being circulated by Grinnell Co., Inc., Providence, R. I., in which a brief story of 70 years development of several inter-related industries, founded on industrial piping, is given. The booklet is interesting and contains a number of illustrations of the company's various plants.

PNEUMATIC TOOLS.—The Independent Pneumatic Tool Co., Chicago, has issued a circular, describing its pneumatic tools. The circular points out that the drills are the only ones manufactured in this country having Corliss valves, and also states that they have one piece pressed steel connecting rods and pistons. Roller bearings on each end of the crank shaft reduce friction.

BUCKETS.—The Industrial Works, Bay City, Mich., is circulating an illustrated booklet, in which clam-shell buckets, which it manufactures, are described and illustrated. These buckets have hardened steel bushings in lower ends of connecting rods, steel rope guard extending completely around power wheel to prevent fouling of the closing line; large heavy power wheel, bushed; hard alloy steel idler sheave, bushed, closing line, guarded against chafing; opening line does not enter bucket and steel shaft bearings. Other parts of the buckets are described. Illustrations show the buckets in actual use.

ALLOY STEELS.—The Climax Molybdenum Co., New York, has published an illustrated booklet, in which the development, history, use, etc., of molybdenum steels, are given. The booklet is profusely illustrated, and contains a number of interesting tables, and other data showing tensile strength, physical properties, etc., of the various molybdenum steels. According to the booklet, molybdenum does not volatilize nor oxidize out of the bath and the metal can be introduced into steel as easily as any other alloy. Methods of making molybdenum steel by the open hearth and electric furnace processes are given in the booklet. The booklet should be of interest not only to steel makers, but steel products manufacturers as well. According to the booklet, before publication of the data which it contains, the company submitted all data to officials and metallurgists of some of the largest alloy steel manufacturers and consumers in the country, to pass on the statements.

CHIMNEYS.—An illustrated booklet has been published by the Portland Cement association, in which concrete chimneys for use at industrial plants are described and illustrated. The illustrations show chimneys at the plants of the Havana Railway, Light & Power Co., Havana, Cuba; Peet Bros. Mfg. Co., Berkeley, Cal.; the Minnesota By-Products Coke Co., St. Paul; the Excelsior Motor Mfg. & Supply Co., Chicago; the Brown Shoe Co., St. Louis; the Burnside, Ill., shops of the Illinois Central railroad, and the Saganoseki Copper Co. smelter at Sagahoseki, Japan. Each illustration is accompanied with dimensions and other data.

PYROMETERS.—The Brown Instrument Co., Philadelphia, has published an 88-page illustrated booklet in which pyrometers are described and illustrated. The pyrometer consists of a thermo-couple and a galvanometer. The thermo-couple is formed of two wires of different alloys, joined at one end, and when this junction is heated it generates a small current of electricity. The current is sufficient to operate an electrical instrument or millivoltmeter. As the temperature of the thermo-couple rises and falls, the thermo-electric current increases or decreases, and is indicated on the instrument in degrees Fahrenheit, Centigrade or in millivolts. The use of this instrument in heat treating plants, blast furnaces, glass plants, ceramic kilns, cement plants, for finding the correct temperature of molten metal in foundries, and in various other industrial plants is described. The construction of the various types of pyrometers and their accessories are described and illustrated in detail.

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German Foundries Face Big Tasks

Output Is at Low Ebb Due to Lack of Raw Materials and Labor Factors—Great Steel Foundry Expansion During the War—Mechanical Equipment of Plants Is Complete

BY H. COLE ESTEP
European Manager of The Foundry

IT HAPPENED to be the privilege of the writer to attend a meeting of the Berlin section of the Verein Deutsche Giessereifachleute — literally translated, Society of German Foundry Specialists—on the evening of Feb. 19, 1920. It took place in one of the numerous large committee rooms in the splendid building of the Verein Deutscher Ingenieure, which stands in Berlin alongside the famous Brandenburg gate, in these days the scene of revolutionary uprisings. Had any other Americans interested in the foundry business happened to have looked in on this gathering at the same time, they also probably would have been impressed by the tremendous contrast between the orderly, even commonplace, procedure at this meeting and the real state of affairs, bordering on chaos, surrounding the German foundry industry today. They might also have come to the same conclusion as the writer, that there is even yet opportunity to reconstruct the business of producing castings in the realm of the former kaiser on a basis approximating its previous prosperity, if industry can only be given the right of way, and political disturbances checked.

The subject under discussion at the

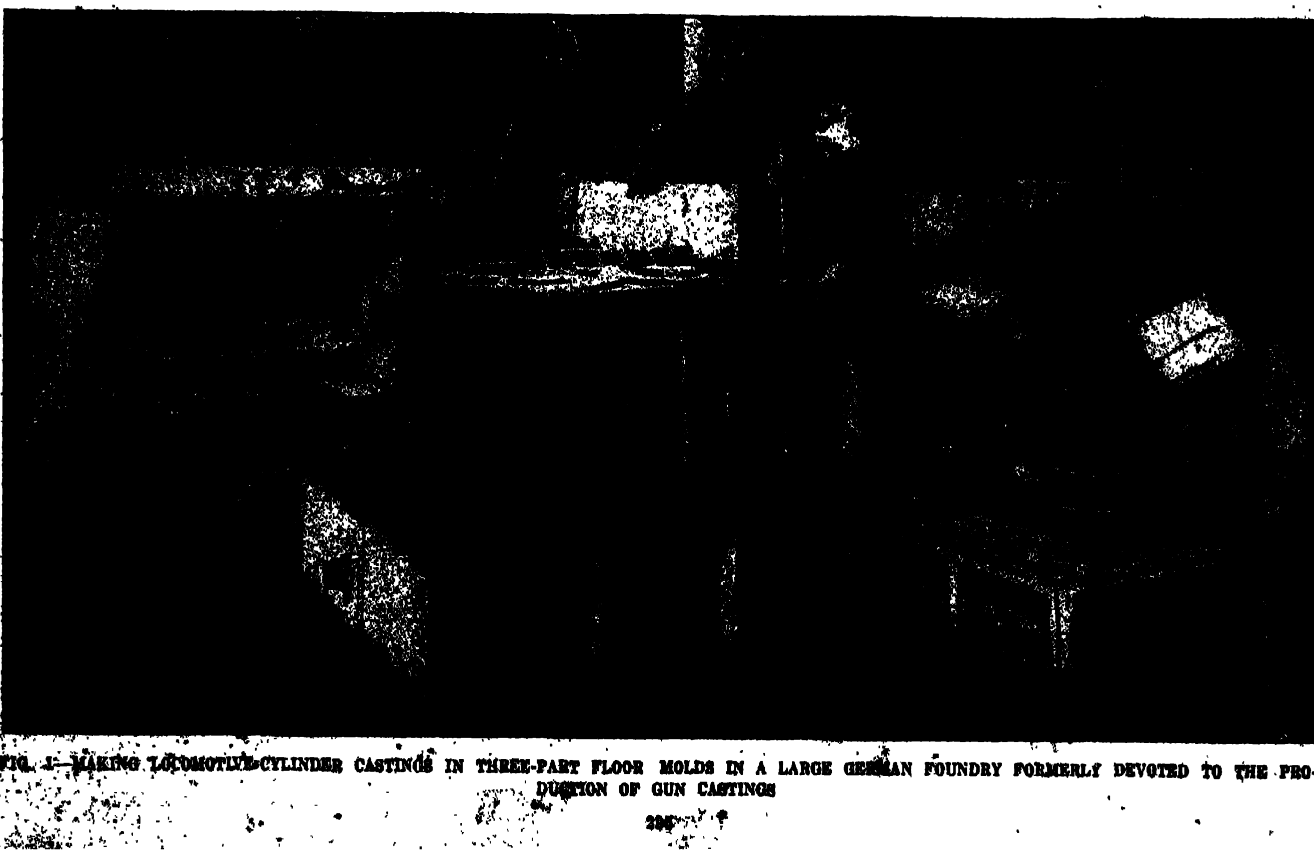


FIG. 1—MAKING LOCOMOTIVE-CYLINDER CASTINGS IN THREE-PART FLOOR MOLDS IN A LARGE GERMAN FOUNDRY FORMERLY DEVOTED TO THE PRODUCTION OF GUN CASTINGS

Germany Developed Enormous Steel Casting Capacity

NO BETTER instance is offered of the tremendous industrial effort put forth by Germany during the closing years of the war than is furnished by a careful study of the growth of steel castings production during the period from 1916 until the armistice. In 1913 Germany's annual production of steel castings of all classes as given by Mr. Estep's figures, in the accompanying article, was only 34.9 per cent of the total shown by the report of the American Iron and Steel institute. During the succeeding years of the war, although American steel castings production was increased to a marked degree, the German output increased at a greater rate until finally in 1917, when the last supreme effort was made to crush allied opposition, the production of all classes of steel castings in Germany exceeded the American total by 2.1 per cent. The large increase in acid-steel castings was a feature of German steel foundry activity as is noted in Mr. Estep's analysis. The same condition held true in American practice, as the combined production of acid open-hearth and bessemer castings in 1918 surpassed the 1913 output by 53.2 per cent. Further, the open-hearth production for that year in America exceeded all previous records. A detailed and graphic comparison of the steel foundry activity of the two nations may be made from the following table:

	Basic Open-Hearth		Acid Open-Hearth and Bessemer		Total Steel Castings		
	American	German	American	German	American*	German	Comparison with American output at 100%
1913	460,161	219,529	530,561	107,580	1,020,711	357,109	34.9
1914	334,144	207,471	336,055	85,837	693,246	293,308	42.4
1915	333,103	451,157	494,705	197,041	866,824	649,498	74.9
1916	605,512	755,405	713,728	423,900	1,371,763	1,179,305	85.9
1917	558,568	655,577	813,860	815,565	1,441,407	1,471,042	102.1
1918	505,880	547,114	795,794	747,115	1,411,110	1,294,233	91.9

*Includes Crucible, Electric and Miscellaneous

meeting attended by the writer was the reclamation and utilization of foundry wastes such as spent sand, gangway spillings, waste metal in the cupola drop, etc. Following the presentation of the paper which dealt with this subject, there was more free discussion and consideration of technical details than frequently takes place at similar assemblages in the United States. Since this German organization deals exclusively with the technical side of the foundry business, there was scarcely anything in the regular program to differentiate the meeting from the thousands which took place in Germany prior to the war. In fact a fleeting impression was given of the old powerful Germany, but this impression was purely on the surface. One does not have to delve very deeply into German casting manufacture at present to discover the tremendous changes which have resulted from the war, or to visualize the huge problems which must be solved before orderly production can be re-established on a profitable basis and a normal output again attained.

Table I

German Steel Castings Output

From Official Statistics of German Foreign Office

One Metric Ton is 2204.6 Pounds

Year	Basic steel castings (Metric tons)	Acid steel castings (Metric tons)
1913	253,587	109,329
1914	210,845	87,243
1915	461,816	198,213
1916	767,586	430,703
1917	666,237	828,837
1918	556,010	750,260
*1919	200,000	375,000

*Estimated.

At the present time there are approximately 2700 iron and steel foundries in Germany, together with upwards of 4000 nonferrous metal shops. The latter figure includes many exceedingly small establishments, or more correctly minor departments of small machinery-building plants. These figures were unofficially compiled by Dr. E. Leidig, director of the Deutsches Giesserei Verbandes, or German Foundry society.

The distribution of Germany's iron and steel foundries is shown on the accompanying map, Fig. 2, which was prepared by the German government's foreign office for its own use in the peace negotiations. The surrendered and occupied areas are shaded on this map. The great concentration of plants in the vicinity of Cologne and Dusseldorf on the Rhine is clearly indicated. It is in this district that most of the large plants are located, and the truth of the statement that some 30 per cent of Germany's foundry capacity has been permanently or temporarily surrendered is evident from a study of the map. The chief foundry centers in unoccupied Germany are Essen and Dortmund, together with Hamburg, Berlin, Leipzig and Chemnitz.

During the war, according to the authority previously quoted, the number of iron and steel foundries in Germany was increased by about 500, or 23 per cent. This by no means, however, measures the increase in capacity, particularly *in the steel foundry* field. The latter is much more graphically shown in Table I, which gives the production of acid and basic steel castings during the past seven years. It is believed that these figures have not been previously published. They are official and represent a startlingly interesting development. As the table shows, the output of acid steel castings in 1917 was 760 per cent of the tonnage produced in 1913. In tonnage the increase was from 109,329 metric tons to 828,837 metric tons. This production dropped to 750,260 tons in 1918 and to approximately 375,000 tons in 1919. It is still over three times the prewar level. These figures throw an interesting sidelight on Germany's technical activities during the war, the large increase in the production of acid steel castings being of course absorbed in the manufacture of ordnance and munitions. At present they are going largely into railroad work, motor trucks, etc. It is evident that German engineers consider the acid process of

Table II

German Pig Iron Output

From Official Statistics of German Foreign Office. Up to 1919 foundry and hematite pig were lumped together, the latter being largely used for acid steel castings. Castings poured direct from blast furnace metal also are included in all years.

One Metric Ton is 2204.6 Pounds

Year	Production, foundry and hematite pig iron plus direct-metal castings Metric tons	Percentage of 1913 output
1913	3,657,326	100
1914	2,494,832	68¼
1915	2,288,538	62½
1916	2,019,991	55¼
1917	2,012,277	55¼
1918	1,660,716	45½
1919	*575,525	....
	†837,781	....
	‡1,413,306	38½

*Hematite only. †Foundry iron only. ‡Hematite plus foundry.

making steel castings superior to all others.

While the production of basic steel castings also showed a large increase during the war, it was by no means as great as that of acid castings. The maximum increase in this latter form of cast metal, in 1917, was 262½ per cent of the 1913 output, according to the official statistics which show that 253,587 metric tons of basic castings were made in 1913 compared with 660,237 tons in 1917. In 1918 this decreased to 556,010 tons and in 1919 to approximately 200,000 tons. German steel foundries enjoyed an enormous expansion during the war and this is now affecting production in a correspondingly unfavorable degree, the output at the moment being not over one-third of capacity.

Unfortunately such complete statistics are not available regarding the production of iron castings. Some indication of the activities of this branch of the German foundry industry are contained in the figures covering the output of foundry pig iron. Official statistics are available covering this material. They are presented in Table II. It is evident from these figures that the gray-iron foundries enjoyed no such expansion and prosperity during the war as the steel-casting branch of the industry. In fact the reverse was the case. The production of foundry and hematite pig iron in 1913 was 3,657,326 metric tons. At no time during the war or since has this figure been reached or even approached. The 1914 output was only 68¼ per cent of that of 1913 and the corresponding ratios for the succeeding years are as follows: 1915, 62½ per cent; 1916, 55¼ per cent; 1917, 55¼ per cent; 1918, 45½ per cent; 1919, 38½ per cent. The production of foundry pig iron, exclusively, not including hematite which is consolidated with foundry-iron production in the figures covering the years 1913-1918, in Germany within the new borders laid down by the peace treaty was only 837,781 tons in 1919, estimating the output for the months of November and December. This clearly reflects the low ebb to which the operations of the German iron foundries have been reduced. This has resulted, in general, from the shortage of raw materials, particularly coal and iron and the seriously impaired labor morale. There has been no lack of demand on the part of the consumers. In fact practically every producer of castings in Germany is fully booked up with orders to the limit of his output under existing conditions. The comparatively better steel casting showing at present is due not only to greater demand but to the relatively greater strength of very large steel-casting producers like Krupp's, which control their own raw materials to a large extent.

Big Price Advances

In the meantime, the advances in the prices of castings, expressed in German marks, have been enormous. The extent of these advances is reflected by the quotations on foundry pig iron which more than doubled in the six months between October, 1919, and March, 1920. In this connection the quotations on No. 1 and No. 3 German foundry pig iron since 1913 presented in Table III are exceedingly interesting.

The prewar spread of approximately five marks per ton, nominally $1.25, between the two grades of foundry pig iron has practically disappeared. In fact melters are glad at the present time to get pig iron of almost any description and efforts have been made even to use forge iron. *Abfalleisen*, or waste iron recovered from the cupola drop is now selling for 1300 marks per ton.

The reader should be cautioned against the indiscriminate conversion of these German quotations into American money at the prevailing rates of exchange. It is possible by this means of course to convert the prices accurately, but it is virtually impossible to translate the values involved due to the fact that the German medium of exchange is now practically valueless. Therefore, while German foundry pig iron even at the present price in marks, may be said to be quoted at only about $16 per ton, this by no means represents the situation from the standpoint of the German foundryman. Such price conversions in fact are utterly valueless except in dealing with export business.

In the latter case the large producers are now scaling their export quotations up to the world-price level. This operation, which the Germans term *Die Valuta*, is in fact now legally compulsory. In this way the Germans hope to realize greater credits abroad for such commodities as they are able to export, thus increasing their ability to buy food, iron ore and other necessary raw materials. It is exceedingly doubtful, however, if such exports in the casting field will amount to much this year owing to the tremendously decreased production already indicated, and to the general exhaustion of commodities and morale. From the standpoint of the German producer of castings, Germany instead of being one of the lowest cost countries in the world is one of the highest.

This is reflected not only in the tre-

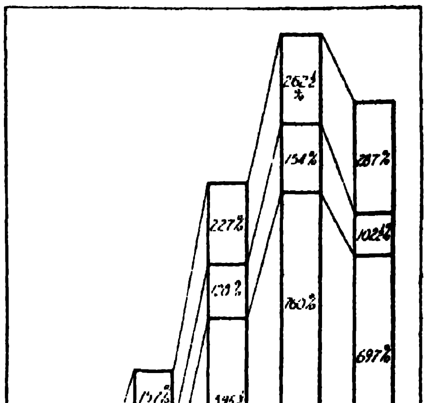
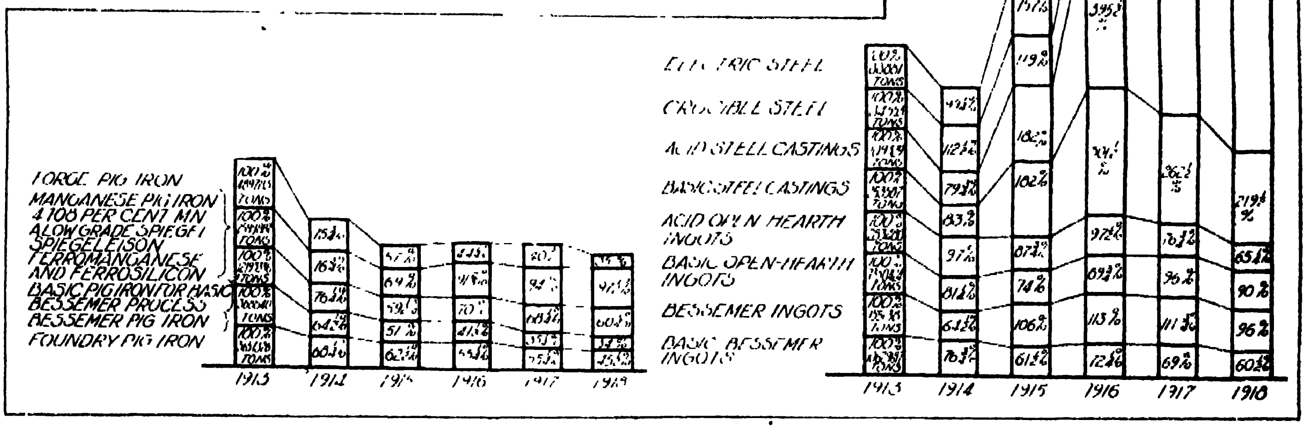



FIG. 2—CHART SHOWING FLUCTUATIONS IN PRODUCTION OF PIG IRON AND STEEL CASTINGS IN GERMANY FOR SIX YEARS, BY COMPARISON WITH 1913 OUTPUT

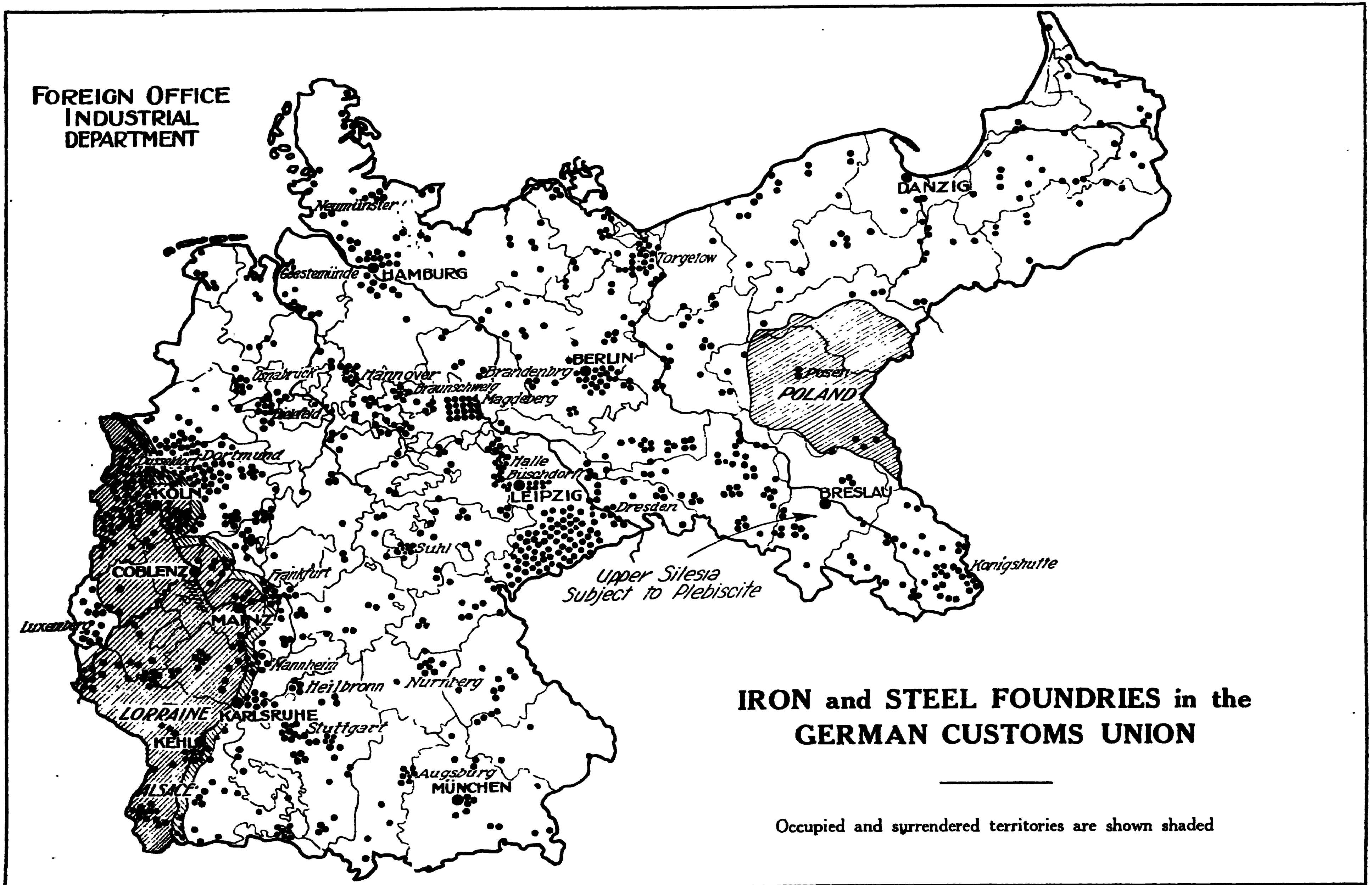


FIG. 3—OFFICIAL MAP PREPARED BY GERMAN FOREIGN OFFICE FOR PEACE CONFERENCE PURPOSES SHOWING LOCATION AND DISTRIBUTION OF ALL THE IRON AND STEEL FOUNDRIES IN THE FORMER GERMAN EMPIRE

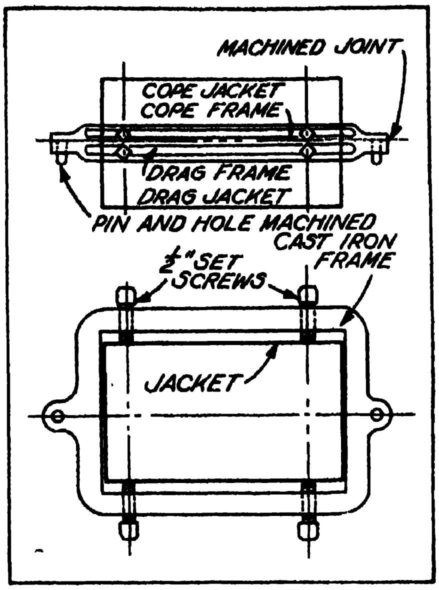


FIG. 4—SKETCH OF FRAME FOR CENTERING MOLD JACKETS ON SQUEEZER MACHINE

mendous prices for pig iron, expressed in marks, but by the great wage increases which have taken place during the past seven years. Before the war unskilled labor in German foundries earned about 6 marks a day on a 9 or 10-hour basis, today the pay is 25 to 30 marks for an 8-hour day. Skilled molders in Berlin, who earned 1 mark an hour on a 9-hour basis before the war, are now receiving from 4 to 4.50 marks, or from 32 to 36 marks for 8-hours work. The hourly rates for molders are slightly lower in Berlin than elsewhere in northern and western Germany, where 5 marks an hour is the prevailing rate.

This discrepancy in favor of Berlin results from the fact that the Berlin foundry employers have a strong organization. There was a serious strike in the foundries of Berlin, which lasted for 60 days through October and November last year. It was finally settled, however, on a mutually satisfactory basis.

Recently, for the first time since the revolution of November, 1918, it has been possible also to revert to a large extent to the piecework system of wage payment in Berlin foundries. As a result, production, which in some cases had fallen to 30 per cent of the output per man-hour in 1913, has been materially improved. The wages earned have been correspondingly increased up to a maximum of 50 marks a day in some cases. It does not seem possible, however, that prewar labor efficiency can be re-established completely until general food conditions are greatly improved.

Malnutrition is a serious factor in German industrial life at the present time and its effects of course are particularly evident in strenuous occupations like iron molding. A noonday scene in a German foundry today forms a startling reproduction of the bivouacs of the Kaiser's army during the war. The men, for lack of other clothing, practically all wear their old uniforms, and their meal consists of virtually nothing else but soup of uncertain quality and composition, served out in army bowls and backed up by a little bread of about the color of an old tan shoe on which they must subsist.

Employers Seek Food for Men

The larger producers of castings are making special efforts to provision their employes. This in fact is almost necessary to maintain any semblance of labor morale. In one case recently, a gang of men on a heavy job were each given a special donation of three pounds of meal, a pound of lard and two pounds of corned beef. Amid the abundance of America, it is almost impossible to understand how industry can be conducted under these conditions.

The necessity for taking direct steps to secure food has also led many large producers of castings to demand at least half of the purchase price in foreign exchange, preferably dollars, although Dutch, Swedish or English credits are equally acceptable. On account of the low value of marks, the German banking system is exceedingly disorganized and the sale of products on a direct cash basis is tending to become the exception rather than the rule. Business in the foundry line, as in other fields, is being reduced to the primitive barter basis. The exhaustion of raw materials also is such that in many cases purchasers are asked to furnish a substantial quantity of their tonnage in the form of scrap, suitable for charging in the cupolas or steel furnaces. In some cases as much as 50 per cent of scrap is demanded before an order for castings will be accepted by the German casting manufacturers.

The reversion to piecework has been brought about in many cases at the request of the men themselves. In some shops referendums have been held from time to time on this subject during the past year. The number of votes cast in favor of piecework gradually increased until recently decisive majorities have been returned in favor of this method of wage payment.

One of the reasons for the greatly decreased output in German iron foundries is found in the stagnation which exists among the great shipyards in the vicinity of Hamburg and Bremen For the time being these plants are practically at a standstill owing to treaty complications and other causes. now in order, which will increase the

Table III

German Pig Iron Prices

Price, Marks Per Metric Ton

	No. 1 foundry	No. 3 f
Jan. 1913	77.50	74.
Jan. 1914	75.50	70.
Jan. 1915	79.50	74.
April 1915	86.50	81.
July 1915	94.00	89.
Mch. 1916	96 00	91.
Jan. 1917	121.00	116.
May 1917	124.90	119.
Aug. 1917	132.90	127.
Oct. 1917	141.50	136.
Oct. 1918	161.50	156.
Jan. 1919	250.00	249.
April 1910	340 00	339.
May 1919	391.00	390.
June 1919	405.00	404.
July 1919	439.00	438.
Aug. 1919	517.00	516.
Oct. 1919	652.00	651.
Dec. 1919	914.00	913.
Feb. 1, 1920	1637.00	1636.

demand for castings, inasmuch as the peace treaty requires the Germans to construct 200,000 tons of shipping per year for the allies during the next five years. In addition the Germans say they hope to build at least 250,000 tons annually for their own use.

Another favorable factor is the great

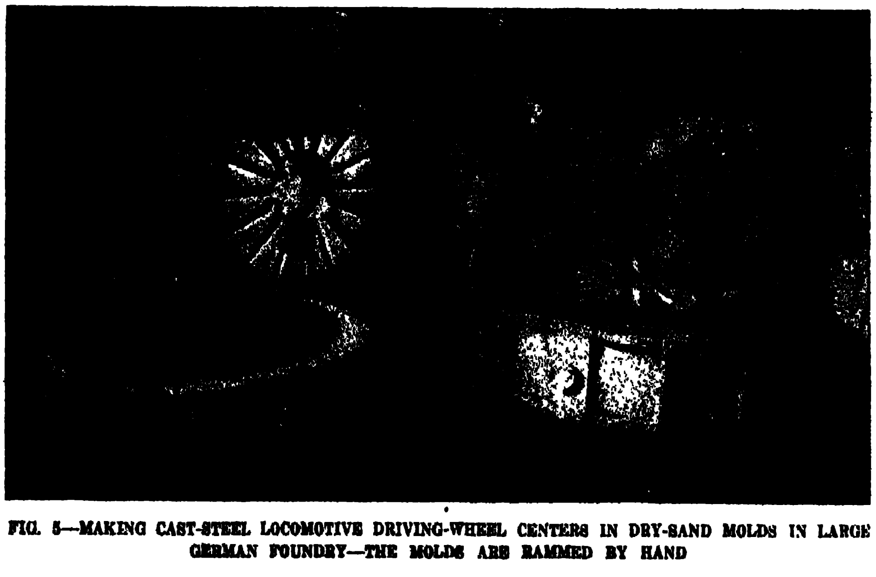


FIG. 5—MAKING CAST-STEEL LOCOMOTIVE DRIVING-WHEEL CENTERS IN DRY-SAND MOLDS IN LARGE GERMAN FOUNDRY—THE MOLDS ARE RAMMED BY HAND

demand for railway equipment. Germany is now building locomotives at the rate of 120 per month for which of course a large number of iron and steel castings are required. Krupp's alone at Essen are turning out 300 standard locomotives annually. Nevertheless, their huge cast-steel foundry at Essen is operating at only about one-third of its capacity.

The technical proficiency of German foundrymen has always been of a high order and in this direction of course there has been no deterioration on account of the war. In fact, many new practices have been adopted, not a few of which appear to be of permanent value. For instance, owing to the shortage of raw materials, extensive use is being made of magnetic separators for reclaiming waste metal from the sand, gangway sweepings, cupola drop, etc. In many other directions strenuous efforts are being made to avoid waste.

For instance, in one of Krupp's foundries handling light work, a large number of snap-flasks are saved by simply using band-iron jackets in connection with the squeezer machines. Since the two halves of the pattern for certain castings are molded on separate machines, a special master jig, or jacket frame, Fig. 4, is utilized for centering the two halves of the flask accurately. The flask pins in this case are located on the jig. As soon as the two halves of the mold are put together, the jig is removed leaving merely the jacket to hold the mold together on the floor for pouring. In this way one jig, with its machine-fitted pins, serves for any number of molds.

In general, German foundries seem to approach the American standard in the use of modern equipment, both for molding and handling materials. Jar-ramming machines are extensively employed. As is well known, the hydraulic type of squeezer and roll-over machine is also exceedingly popular. The Germans claim that this type of machine can be operated with a minimum of power consumption. This factor is of no small importance at the present time owing to the shortage of coal.

It is not due to physical equipment that German foundry production is at such low ebb at present. The causes of the present unsatisfactory state of affairs lie much deeper and in fact are bound up with the general disorganization of the country resulting from miliry defeat, the collapse of Germany's foreign exchange, and public disturbances.

Germany is obliged to import not only food but certain raw materials such as iron ore, together with copper, lead and other metals used by nonferrous foundrymen. With marks, however, at only one-twentieth of their prewar value, the country is virtually blockaded against imports. This economic blockade is in fact practically as effective as the military blockade maintained during the war, and operates to aggravate the effects of the latter, which are still in evidence. The solution of the problem for the German foundry business, in common with other metal working establishments, would lie, it seems, in the stimulation of production through the efficient utilization of such raw materials as can be secured within the borders of the country, together with the establishment of a more stable government. Although beset with great difficulties, this appears to be the only path to progress.

Review Graphite Industry

Low-grade amorphorus graphite is abundant in the United States. An excellent grade of amorphous material is available from Mexican deposits owned by a United States graphite company. Extensive domestic development of amorphous mineral has never been profitable on account of this cheap Mexican material.

Artificial graphite and graphitized carbon manufacturers are competitive to some extent, with natural grades. The output has increased greatly in recent years and now forms an important element in the country's graphite supply. Although not yet an accedited substitute for flake graphite in the making of crucibles, it is not improbable that present efforts to develop an artificial crucible grade will finally evolve a satisfactory product. It already is finding an expanding use in lubricants, paints, foundry facings, boiler-scale preventives, and battery fillers, and the manufacture of graphitized carbon electrodes is increasing with the expansion of the electric steel industry.

The growth of the graphite industry in this country has been greatest in Alabama, which produced 59 per cent of the quantity and 66 per cent of the value of the total domestic output in 1917. The production doubled in 1916, and there was a further increase of 50 per cent in 1917. Notwithstanding shipping difficulties, imports also increased. About one-ninth of the American consumption in 1916 was of domestic origin. In 1917 the proportion had increased to about one-seventh, and in 1918 to about one-third. Since the signing of the armistice something of a collapse in domestic production of crystalline graphite has occurred.

The total requirements of the country for 1919 have been estimated at not over 30,000 tons, of which 50 per cent will be crystalline and 50 per cent amorphous. Of the crystalline, only about 15 per cent is expected from domestic deposits; of the amorphous, about 45 per cent.

With the rumor of prospective tariff legislation and the resumption of more nearly normal shipping conditions, the pressure of foreign graphite has increased, says the United States tariff commission in its third annual report. Consumers are declared to be accumulating imported stocks and domestic producers are being correspondingly restricted.

In the graphite industry, interest centers in the material capable of being made into crucibles—the crystalline variety of the mineral. Its most important use is in the manufacture of crucibles for melting steel, brass and other metals and alloys. In addition, to use in crucibles, it has a wide variety of industrial applications, for which a lower grade the amorphous variety is adapted. An artificial graphite, made in the electric furnace, is suitable for many minor uses. The crystalline graphite for the American crucible trade in the past has been almost entirely imported, coming from Ceylon, the world's main source of supply prior to the heavy demands of the war period. Recently Madagascar graphite has been replacing Ceylon material in the European markets, and American crucible makers have had considerable success, both in mixing up to 40 per cent of the domestic flake with Ceylon material and in utilizing 100 per cent Alabama flakes, it is stated.

The report adds:

Although the domestic graphite industry experienced a great stimulation during the curtailment of imports from overseas in 1917-18, the United States is not yet independent in the matter of crucible graphite, 15,000 tons of which are required per year. We produce from deposits in Montana, Alabama, Pennsylvania, New York, Alaska and Texas some 3500 tons of flake (or crystalline) annually, of a grade inferior to Ceylon but similar to Madagascar flake. There are large undeveloped reserves of flake graphite in the United States carrying 5 per cent of the mineral. The Ceylon and Madagascar deposits contain 50 per cent or more. The flake graphite supply in normal times may come from Madagascar, but we can be fairly independent in case of necessity through the stimulation of graphite mining in this country.

A packing metal for use on pistons of steam engines has been patented by C. H. Kline. The alloy consists of copper, 80, and lead, 20 per cent.

Foundry Applies Electricity to Many Operations

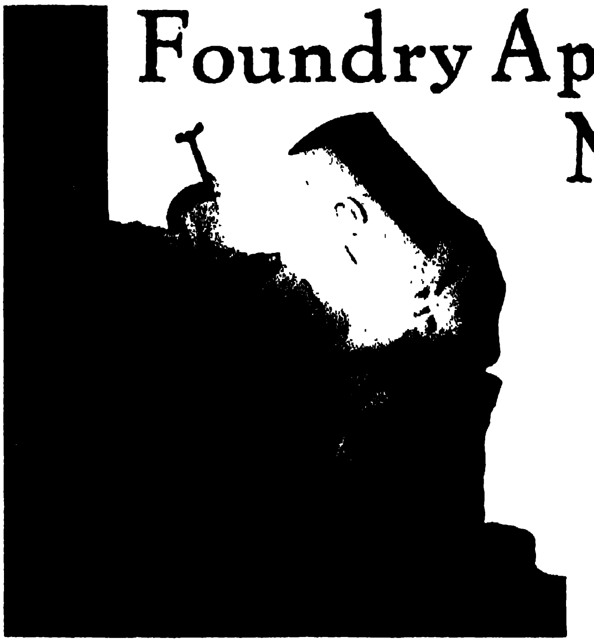


Fig. 1—Slightly defective castings are repaired by electric welding

Company Has Developed Features Which Assist in Economically Melting, Pouring and Heat Treating—Electricity is Used for Making Steel, Baking Cores, Annealing and Heat Treating Castings, and in the Cleaning Room

BY H. R. SIMONDS

WITHIN the span of a comparatively few years, electricity in industrial plants has ceased to be regarded as a luxury and now is universally considered one of the most essential factors to economical manufacturing. First employed for lighting, then for driving machinery and finally for heating furnaces and ovens, electric power has gradually assumed a more important role until now it plays an extremely significant part in practically all branches of the manufacturing industry. That this is particularly true of the casting industry is proved by the increasing number of instances wherein electric apparatus has supplanted other types of equipment. A striking example of the widespread utilization of electricity is found in the steel foundry of the Connecticut Electric Steel Co., Hartford, Conn. In this plant,* the first unit of which was completed early in the war, electric power is used not only in melting and refining the steel, but also for annealing castings, baking cores, repairing castings by welding, cutting off risers and sprues, and driving the mechanical equipment of the casting shop.

During the war the demand for steel and alloy castings became so great that many foundries in New England found it necessary to make additions to existing plants. The Connecticut Electric Steel Co. extended its plant and equipment in an effort to meet this demand and engaged in war contracts which continued throughout most of 1919. The company is just getting back to a 100 per cent peace basis.

The foundry is equipped with two 2-ton heroult electric furnaces, modern molding and pouring equipment, electric annealing and core baking ovens, and a well appointed testing laboratory. While in general the method of operation corresponds to the practice followed in similar electric steel foundries, some details of the casting process are unique and many of the minor difficulties incidental to electric steelmaking have been overcome by some experimental work.

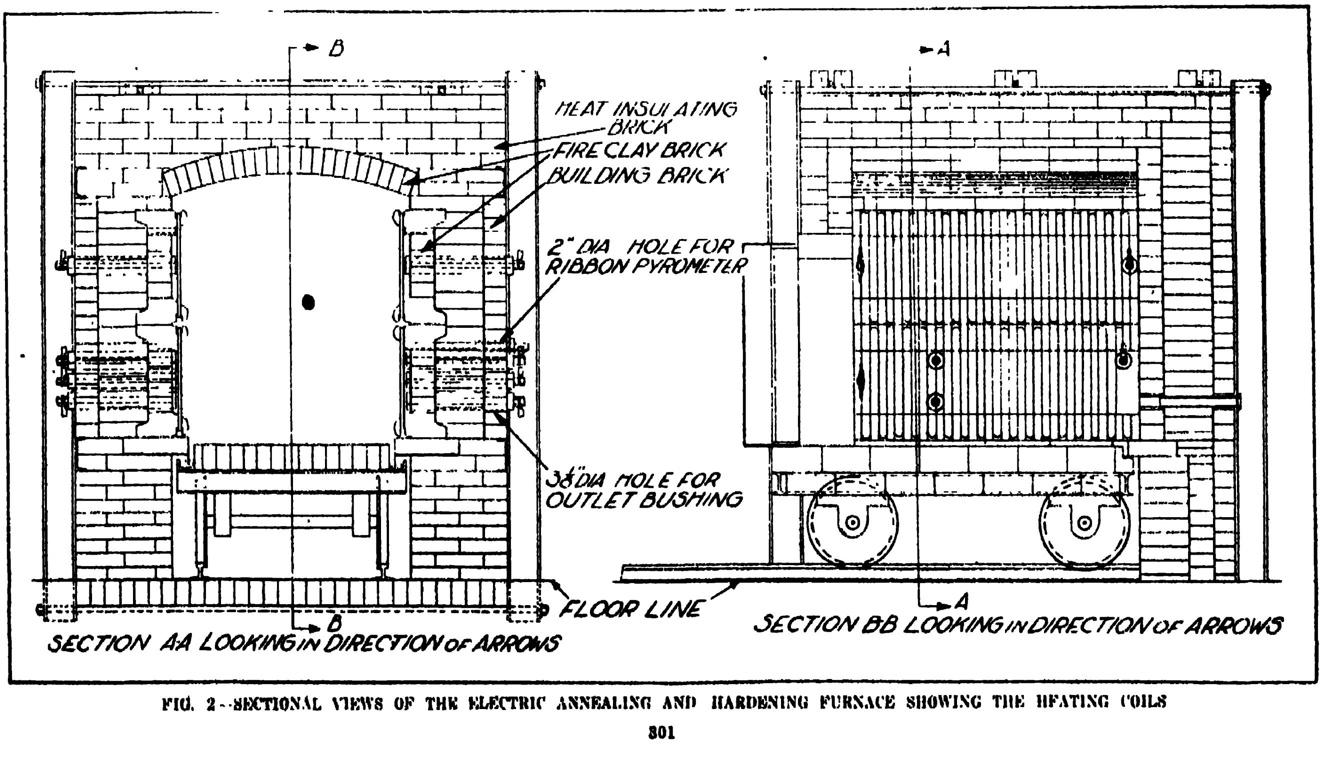


FIG. 2—SECTIONAL VIEWS OF THE ELECTRIC ANNEALING AND HARDENING FURNACE SHOWING THE HEATING COILS

As now operated each of the two furnaces averages three heats per day, although four heats have been made on occasions. The first step in the

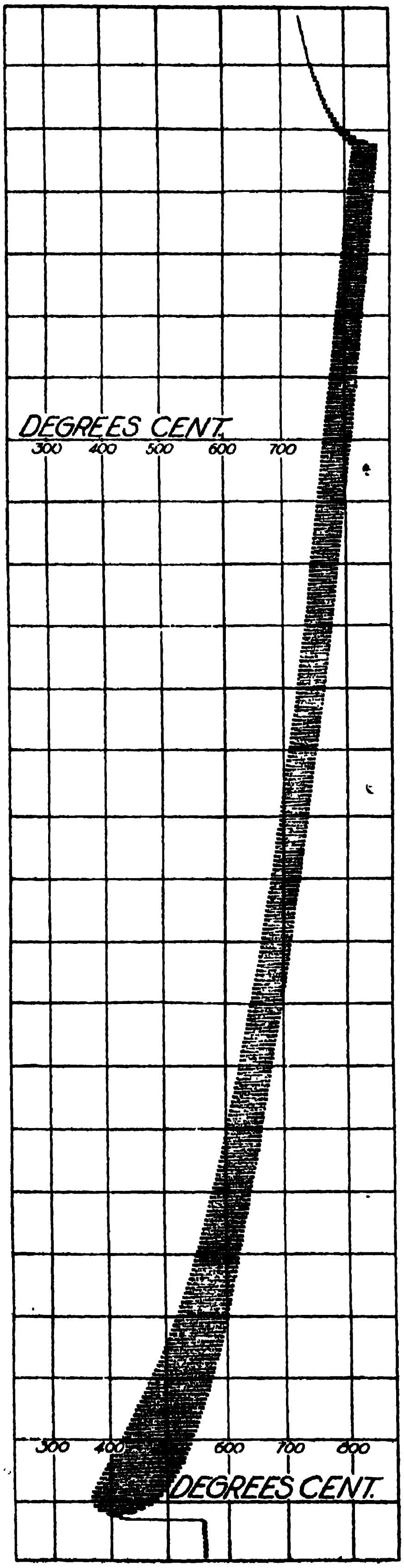


FIG. 3—DIFFERENCE OF TEMPERATURE BETWEEN THE CHARGE AND THE ANNEALING FURNACE IS RECORDED BY A PYROMETER—THE EDGE OF THE CURVE TO THE RIGHT INDICATES THE TEMPERATURE OF THE METAL

cycle of operations for a heat consists of shoveling the charge of scrap steel and pig iron into the side door to the required depth in the usual way. The carbon electrodes are then lowerd to make contact, after which the automatic feeding feature of the furnace takes up the operation and keeps the load at predetermined points. As the three carbon electrodes gradually melt their way down into the mass of scrap, the small craters which from around each electrode arc leveled off with a long rod by one of the attendants. Although this is not necessary, it insures more rapid operation of the furnace.

Increase Life of Ladle Linings

While the melting is in progress, the ladle is being prepared to receive the molten steel. The lining of the ladle is retouched every day and is heated by means of a fuel-oil blow torch just before receiving the metal from the furnace. The question of ladle lining has received considerable care at this plant and by use of selected materials, and attention after each heat the life has been increased from fou- weeks to an average of from six to eight months. When the charge has been completely melted a sample is taken and cast into a small bar for test purposes. The bar is cooled and taken to the laboratory where fine turnings are secured and tests made in the usual way for determining the amount of carbon present. If the carbon is too low, pig iron analyzing 3.50 per cent carbon is added. The company has found that this is the sure-st way to be certain that the same proportion of the carbon added will be taken up by the steel each time. It has been found by experiment in the furnace in question that 100 pounds of pig iron raises the carbon in a 2-ton charge of steel 0.08 per cent.

Should the preliminary test indicate that the steel contains too much carbon, it is necessary to reduce the carbon by oxidation. This is done by adding iron ore or mill scale to the bath. The addition not only oxidizes the carbon in the metal but it also oxidizes the metal to a certain extent and also the slag. Before the metal is ready for pouring these oxides must be reduced. This is accomplished by adding carbon on top of the slag. When properly added the carbon does not come in contact with the steel and so the percentage of caibon in the steel is not incresed by this operation. The steel is also deoxidized by the addition of ferrosilicon.

The amount of carbon in the steel may vary during the heat. Some is oxidized by the varying quantities of rust on the scrap which is used, and by the slag. On the other hand, carbon may be picked up from the slag or from the carbon of the electrodes, especially if portions of the electrodes break off and fall into the bath during melting.

The scrap is mostly fine, principally being made up of small boiler and sheet punchings, and these of course become covered with rust. It was found that by charging the furnace at night the action of the heat on the rust so influenced the melt the next morning that it was impossible to predict the carbon content within many points. The practice now, thereore, is to charge the furnace just before it is put into operation.

In preparing the charge it is important to have the mass as nearly solid as possible. That is, if some large scrap is used, care must be taken to fill the openings with smaller scrap so as to make the mass nearly uniform. Otherwise rifts are apt to occur across which arcing will take place. Such arcs increase the resistance to the current, and the automatic control lowers the electrodes to decrease the resistance This may be carried to such a point that one or more of the electrodes finally rests on the metal, and no arc is formed beneath the electrodes resting on the metal. When the metal melts at the point where the arc was formed between portions of the bath and the arc breaks down, the gap here is closed and the entire circuit is practically continuous. Thus a large amount of resistance is suddenly taken from the circuit and the amperage increases to such an extent, before the automatic equipment can raise the electrodes, that the circuit breaker may be kicked out. To start the current again, the electrodes are raised and then lowered until the arcs are formed. The remedy is to keep the charge as near a solid mass as possible and to rake it together occasionally during melting.

The method used at a number of tool steel works for freeing the metal from the slag during pouring has been adopted at the Hartford plant and has proved satisfactory. It consists of blocking up the entire pouring door of the furnace with the exception of a small hole left at the bottom. In tapping, the slag line comes above this hole and the clean metal from below is then drawn off first into the ladle. By this method the slag is the last to be drawn off and therefore rests on top of the metal in the ladle

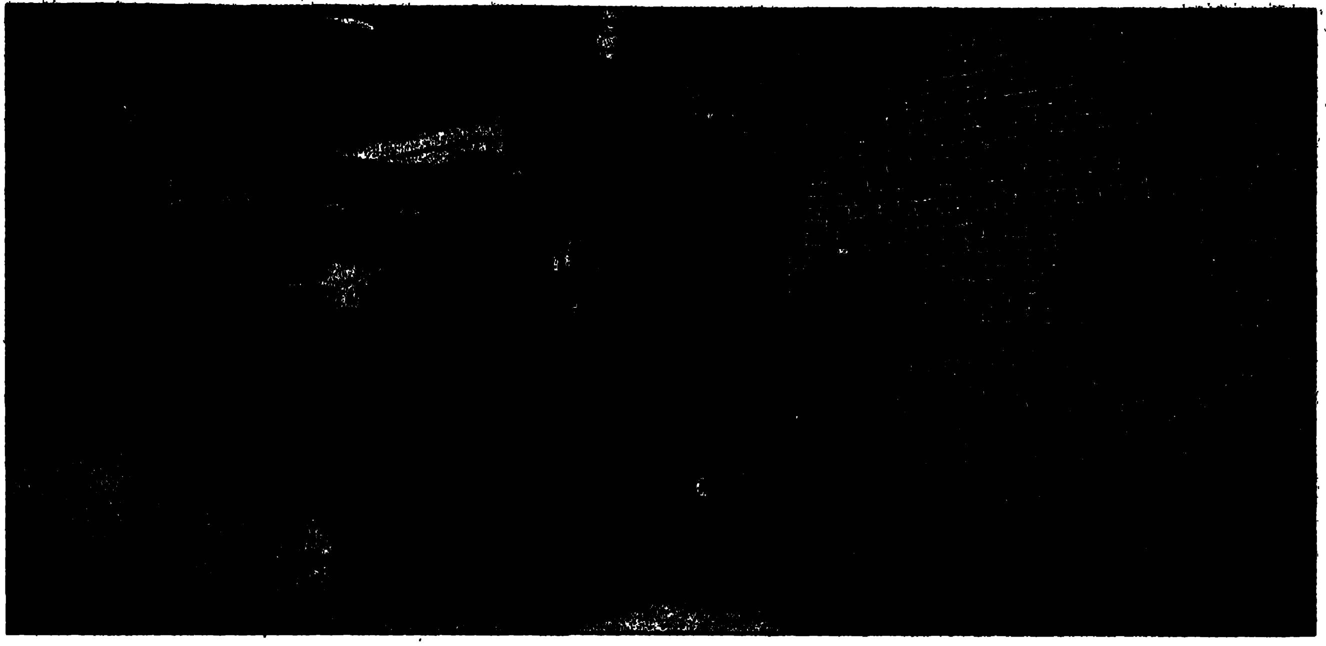


FIG. 4 AN AUTOMATICALLY CONTROLLED CORE OVEN IS PART OF THE PLANT'S EQUIPMENT

without mixing with it during pouring.

When it is desired, as in the case of making tool steel and certain alloys, to remove the slag before the final melt is complete, this is done by taking off the entire melt as just described and then running all the metal back into the furnace from a bottom-pour ladle, leaving the slag in the ladle to be run into the slag pot later. However, a second slag usually is not necessary in making steel castings from a good grade of scrap. The steel is then poured as it is first tapped from the furnace with a blanket of slag on top of it in the ladle to form a heat insulating coating.

A normal heat in the Hartford plant takes approximately two hours from the time the current is on until the metal is ready to pour. The carbon electrodes burn off quite rapidly. Records kept in the case of one of the furnaces indicate that about 35 pounds of carbon burn off for each heat of 2 tons. This includes breakage, which sometimes occurs at the bottom of the carbon rods where they come in contact with the steel scrap of the charge

One of the features of the plant is an electric annealing and heat treating furnace equipped with an automatic thermostat control. Recording pyrometers give a 2-point curve or chart showing the temperature of the piece which is being treated and also of the oven. Such a chart is shown in Fig. 3. The lower edge of the curve indicates the temperature curve of the steel which is being treated, and the higher edge shows the temperature of the furnace. The curve was obtained from two thermocouples. One registered the temperature of the furnace. The recording instrument then was switched to the other couple which registered the temperature of the steel. This procedure was repeated at short intervals as may be noted from the chart.

At the bottom of the chart it will be noticed that there is a wide difference in temperature between the work and the furnace, but this difference is gradually reduced as the furnace warms up until the two lines on the chart become practically parallel. The arrangement of the electric annealing furnace is shown in Fig. 2. The heating coils extend above the top of the door in order to give additional heating surface inside of the core oven.

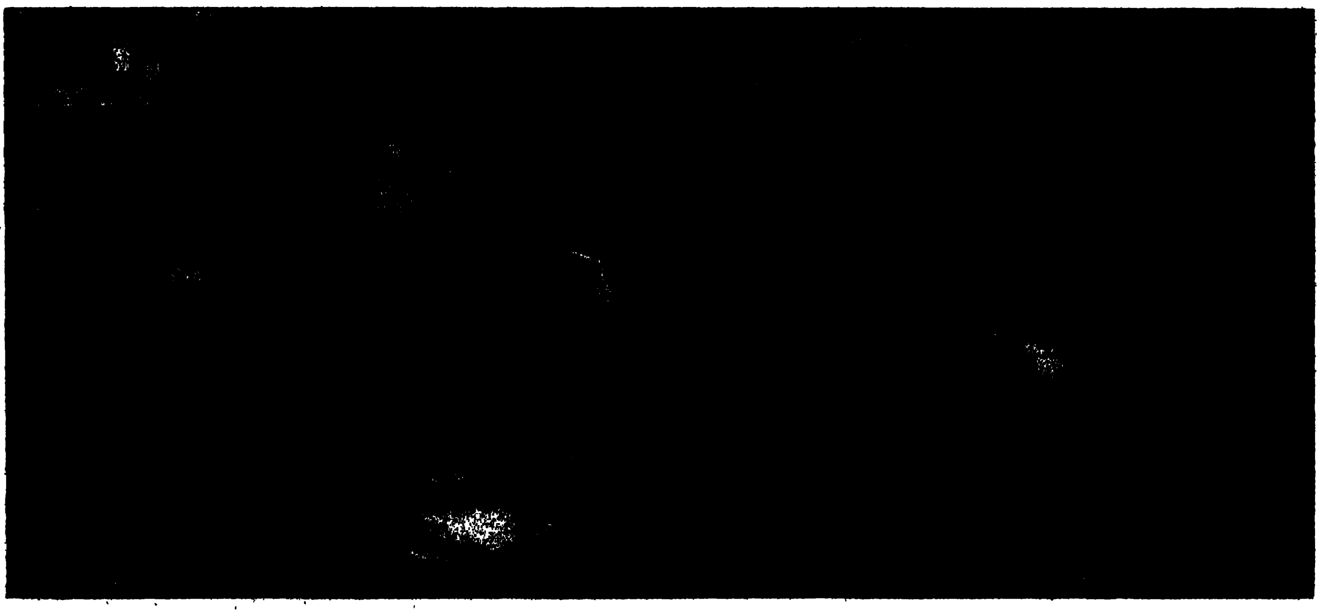


FIG. 5—CRATERS WHICH FORM AROUND THE ELECTRODES ARE LEVELED TO INCREASE THE SPEED OF THE FURNACE

Manufacturing Chilled Iron Car Wheels - II

Cupola Practice and Methods of the Core Room Are Described

BY H. E. DILLER

UNIFORMITY of metal composition is essential in chilled iron car wheels. This uniformity of metal is guarded by watching closely the pig iron and scrap charges, and by collecting approximately two charges of melted metal in the cupola before tapping. This metal is further mixed by pouring it into a large receiving ladle. Pig iron for car wheels is bought to specification and many foundries pile each car on a separate pile, or, if more than one car is placed on a pile care is taken that the composition, particularly as to silicon content, agrees closely

In most foundries engaged in car-wheel production, pouring is started early in the morning and continued all day. This makes it necessary to use a flux for slagging the iron, and limestone is almost universally used for this purpose. This gives good results when added in the proportion of 25 or 30 pounds to a ton of metal. Sometimes fluorspar is added with the limestone. The addition of the fluxes makes a large amount of slag and means must be provided to get this away from the cupola. Slag pots which dump furnish a convenient means for accomplishing this. In one foundry these are arranged on a revolving column as illustrated in Fig. 7. As the pots are filled they are swung away from the slag spout and by the time they have solidified they have been moved around until they are immediately above an industrial car into which the slag is dumped and carried to the refuse pile. All foundries break the scrap wheels before putting them into the cupola. This is effected by dropping a weight, either in the form of a ball or as a hammer on a guide as shown in Fig 6. The wheel to be broken is placed on a cast-iron ring which has a hole in the center, slightly larger than the hub of the wheel. The weight is raised to a fixed height and automatically released. The first blow always breaks the wheel The danger from flying particles is obviated by partially enclosing the drop machine in three walls of heavy oak boards After the wheel is broken the pieces are loaded upon a flat car on which pig iron has been placed.

The smaller the pieces into which the wheel is broken, the better are the melting conditions obtained It is even asserted that when the wheels are broken fine, the melting ratio is lowered. However, this fact is not always given consideration by the foundryman, possibly because the difference is more theoretical than actual. Some melters are satisfied if pieces no larger than a half wheel are charged Others use a heavier drop weight which breaks the wheel in many pieces, none of which are more than a quarter of a wheel. One foundry has the rule that a whole wheel may be added to every charge

Formerly attention was paid to the source of the scrap wheels, and every wheel from certain foundries was examined after it was broken to determine the depth of the chill. The wheels were then sorted according to the depth of the chill. In more recent years the uniformity of the scrap wheel has become more dependable and less attention is paid the depth of chill of the broken wheels. Occasionally a wheel is found which has too high or too low a chill and only a small portion of it is added to any one charge. Pig iron usually is located near the elevator which carries the stock to the charging platform and the weighing scales customarily are near the center of the stock pile. Pig iron, steel scrap and iron scrap which, as has been said, generally consists solely of returned car wheels, and scrap from the home foundry, are piled together on industrial cars, used for carrying stock to the charging platform. Two cars frequently are used for one charge. Generally the metal from the cars is dumped into the cupola by tilting the car

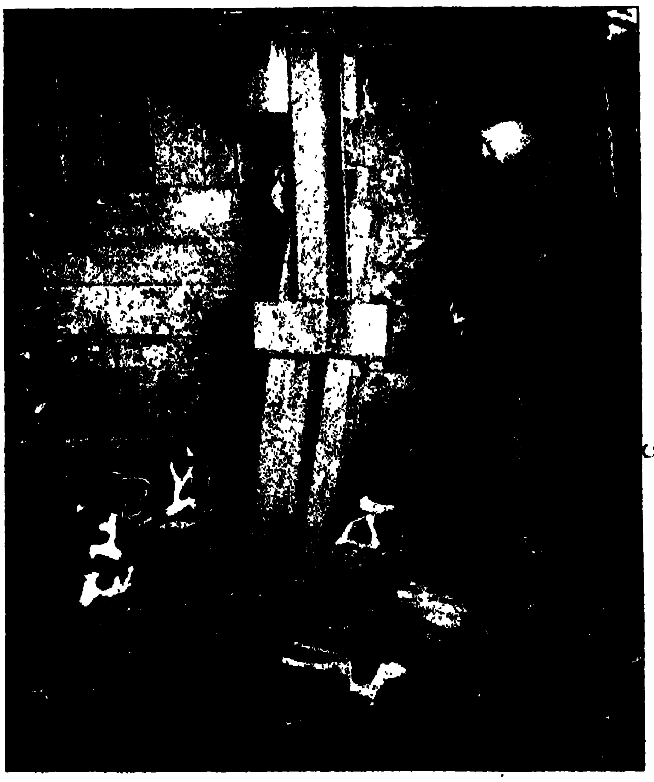


FIG. 6—SOME DROPS ARE FITTED WITH SUCH A HEAVY WEIGHT THAT ITS FALL BREAKS THE WHEEL INTO MANY SMALL PIECES

with a pneumatic hoist. After the iron is dumped into the cupola it is necessary to pull the pieces into place to give a flat, even top to the charge. For this reason some think it economical to charge the second car by hand. This does away with pulling the pieces of the charge about, to produce a level surface. Enough metal weighed and on cars is kept on the charging floor to provide for any emergencies. Two or three hours supply generally is considered sufficient. Fig. 8 is characteristic of the charge and the method of dumping it into the cupola.

Special Cupola Lining

Various devices are employed to protect the sides of the cupola from the abrasion of the metal as the charge is dumped. One of these involves cast-iron blocks for lining the walls of the cupola around the doors. A circle of these castings is formed around the cupola from a point 1 foot below the charging doors to the same distance above the doors. A cast-iron sill is placed in each of the charging doors before starting operations. This sill is 1 foot high, so the effect is the same as though the cast-iron lining was extended 2 feet below the doors. Such linings last about four months, which is considerably longer than a brick lining would serve at the same place.

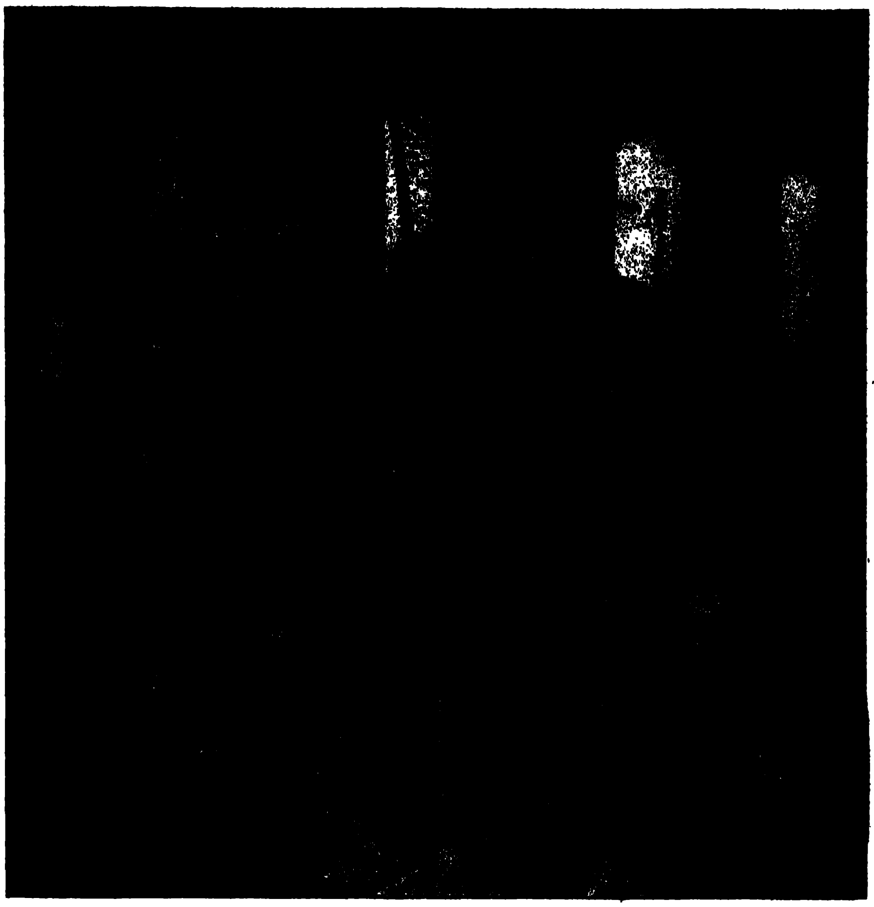


FIG. 8—THE SCENE IS TYPICAL OF A CHARGING PLATFORM OF A CAR WHEEL FOUNDRY. THIS CAR IS DUMPED AT THE SIDE WHEN THE PLATFORM RAISES

Coke usually is forked into the cupola after the metal has been leveled. A novel way of charging the coke is employed in one car-wheel foundry. Here the entire coke charge is thrown around the edge of the cupola and none is placed in the center. In this way the iron from one charge rests on the iron from the next charge, in the center of the cupola. The coke following down the sides of the cupola falls in front of the tuyeres and protects the iron from direct contact with the oxygen of the air which is combined with the carbon of the coke before it strikes the metal.

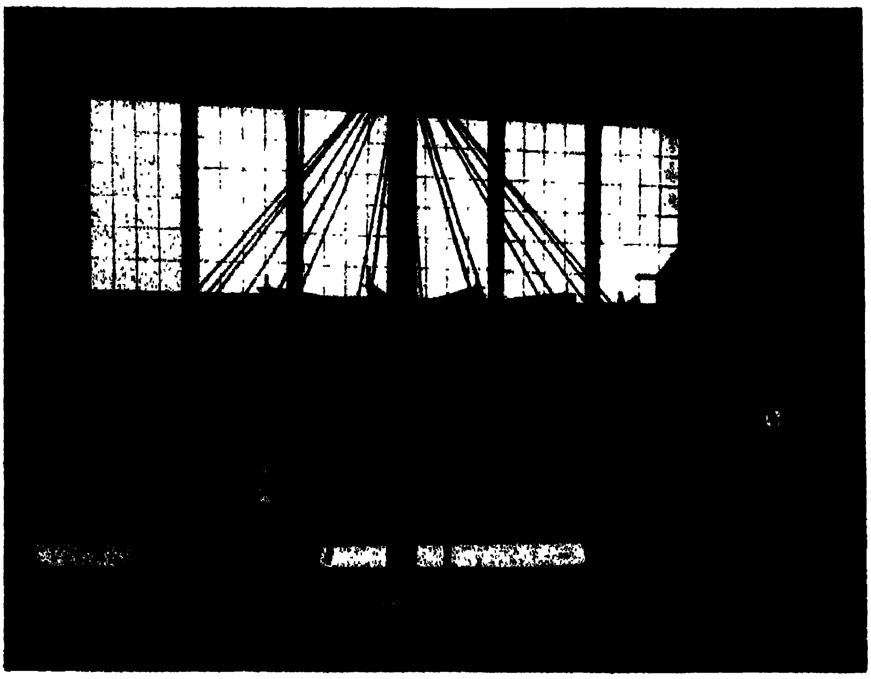


FIG. 7—CUPOLAS WHICH ARE OPERATED DURING THE ENTIRE DAY ARE EQUIPPED WITH MECHANISM FOR CARRYING AWAY THE SLAG

The number of men necessary to operate the cupola in car wheel practice is illustrated by a typical foundry. Here one workman is employed to bring the wheels to the drop and break them. Another pulls out the broken pieces. Four men load the metal and coke on cars, and four more on the charging floor put the metal into the cupola. This gang charges iron at the rate of 19½ tons an hour. The cupola is lined to 80 inches and the metal charge weighs 6800 pounds. Five thousand pounds of coke are placed on the bed.

Regularity of Metal Assured

The first iron from the cupola in the morning is used to heat the ladles and is then poured into pig beds. The custom is to collect from 10 to 15 tons or more of metal in the cupola before tapping. This will include two entire charges, so that when the iron is tapped two complete charges flow into a large reservoir or mixing ladle and there are mixed. This practice helps to insure a thoroughly homogeneous iron free from irregularities of composition. This regularity of the iron is highly re-

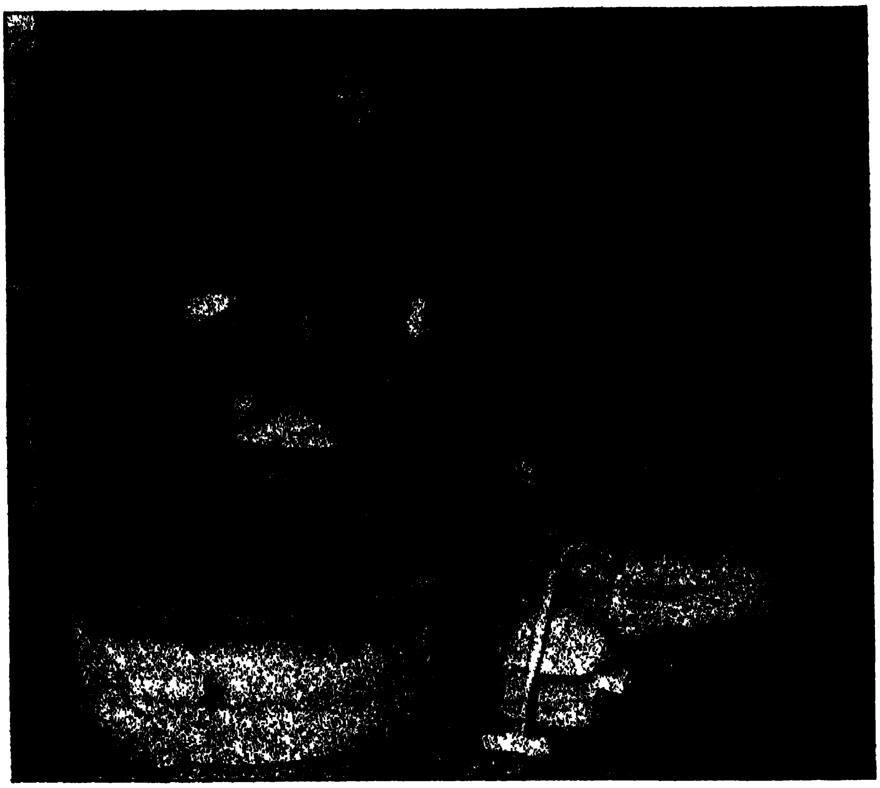


FIG 9—CHILL TESTS ARE SOMETIMES CAST IN CIRCULAR MOLDS THE OUTSIDE RIM OF THE MOLD ACTS AS A CHILLER

quisite, that the chill may come within the limits allowed by the specifications

Close watch is kept to insure that the proper depth of chill is obtained. This is done through chill samples which are taken from every tap of iron. Record is maintained of the wheels cast from each tap by wheel numbers, so that if anything is found wrong with the iron from any ladle all wheels from the iron of that ladle can be located. Often when doubt arises as to the quality of the iron or the depth of chill, the manufacturer has a wheel tested and broken to insure himself that the lot will meet specifications, before submitting any wheels of the melt for the customer's inspection.

Record Kept by Tap Number

The record of the tap number from which each wheel is poured is kept in various ways. Sometimes a clerk who keeps a record of the chill tests, also records the floor to which each ladle is sent, and, as the wheels on each floor are poured in numerical order, this record connects any wheel with the tap number. Another method requires the molder to keep a record of the tap number for each wheel. This may be done on the card, a copy of which is shown in Fig. 10. At the top in pencil is the molder's number, together with the date, wheel size and weight, and the name of the road for which the wheels are to be made The number of wheels to be made is also placed at the head of the card. In the first column consecutive numbers from 1 to 25 are printed. The next column is filled with the serial number for each wheel, by means of a numbering machine, before the card is given to the molder. The first figures of each number are the same and are placed on the pattern. The last two or three figures of each number are not on the pattern but are marked on the mold by the molder. When each wheel is poured the molder jabs a hole in the card adjacent to the corresponding wheel number and marks the tap number in pencil to the right of the wheel number. Twenty-five spaces are printed on the card because, in the foundry at which this particular card is used, 25 wheels constitutes a day's output for one molder and a helper, with the assistance of a third man. This man divides his time between two floors, helping to shake out and carry the wheels to the hot cars which convey them to the annealing pits.

Two chill tests are shown in Fig. 13. The one to the left was taken from the mixture for a freight car wheel of the heaviest weight. The chill to the right was from the metal being poured in a small wheel. The difference of chill is easily noticeable. The few dark marks to the center of the chill to the left are caused by shrinkage.

A method for making chill tests is illustrated in Fig. 9. The flask consists of two cast-iron rings, the one concentric with the other. The outer ring is a predetermined thickness, usually about 2 or 3 inches. The samples vary in size according to the ideas of the man in charge of each foundry. A section 2 x 7 inches against the chill, by 2½ inches thick probably is representative.

Two Chill Tests Taken

The mold to the right, Fig. 9, is being put up. The patterns, which are usually made of metal, may be seen protruding above the chiller. They are set against the chiller and backed with molding sand. After the molds are cast and as soon as the casting reaches a black color a boy pulls them from the mold and quenches them in water. This can be done without causing trouble because iron is not appreciably affected by quick cooling after it is below the recalescent point at which temperature the casting is a dull red. Another lot of chill tests are cast, one each from the same ladles of iron as

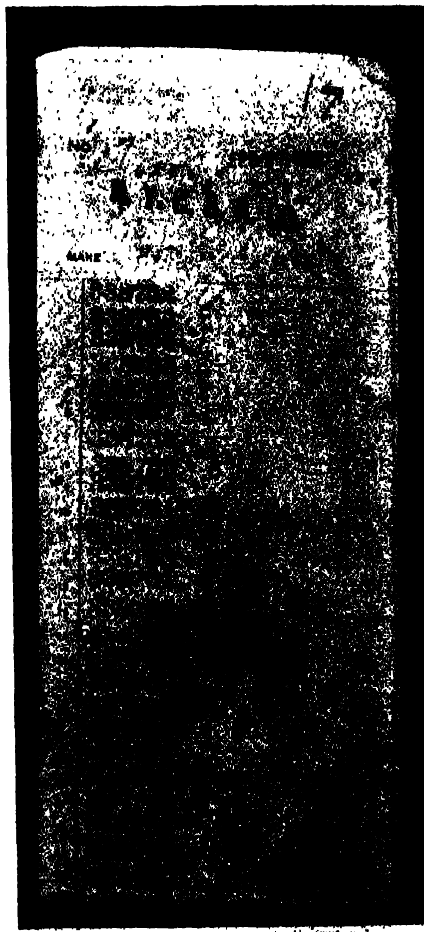


FIG. 10—MOLDERS ARE GIVEN CARDS CONTAINING THE NUMBER OF EACH WHEEL TO BE MADE DURING THE DAY

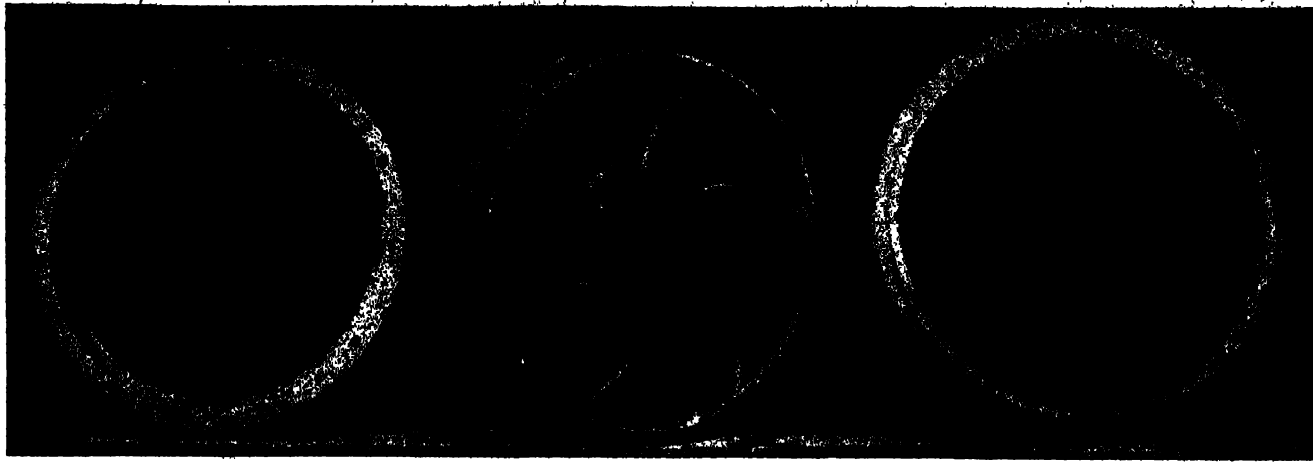


FIG. 11 PATTERNS FOR SMALL WHEELS ARE MADE SO THAT ANY ONE OF A VARIETY OF FLANGES AND RIMS MAY BE PUT ON THE BODY OF THE PATTERN TO MAKE THE STYLE WHEEL ORDERED BY THE CUSTOMER

each of the quenched tests. This second lot of chill tests are allowed to remain in the sand until cool, to check the appearance of the quenched test pieces. This is to guard against error in case the quenched samples should have been cooled before reaching the recalescent stage. However, the quenched test pieces serve to enable a correction to be made at once if necessary.

Should the chill in the sample be too high, the metal may be corrected by the addition of ferrosilicon to the ladle. A ferroalloy of silicon and manganese also is used for this purpose. This will raise the percentage of silicon in the metal and so reduce the depth of chill. When the chill is too low, any one of several remedies can be applied. Steel chips can be added to the ladle. This cools the iron and only a small percentage can be added without deleterious effects. It reduces the percentage of silicon and carbon and so increases the chilling properties of the iron. Additions of small amounts of manganese and iron ore have been tried. These ores increase the chill by oxidizing the metal, but slag is formed by the action and off-sets the benefit to be derived from this remedy. The foundry which regularly adds manganese to the molten iron has an advantage in case the chill is too low. The manganese softens the iron. Therefore, if a portion of it is left out, the depth of chill will be increased. The ability to decrease the chill by the addition of silicon is so much simpler and easier to control than any of the methods for increasing the chill, that the practice is to work on the high side of the chill in calculating the mixture.

A method for breaking the test piece is illustrated in Fig. 9. The

FIG. 12—WHEEL BLANKS ARE HELD IN THE PATTERN SHOP TO SEASON FOR AT LEAST FIVE MONTHS BEFORE THEY ARE TURNED TO MAKE THE FINISHED PATTERN—THUS DANGER OF WARPING IS AVOIDED

chill test is held in the groove of the casting shown in the foreground and broken by blows of a hammer. Occasionally the test piece is laid on a plain support and broken with a hammer. The former method is more simple and obviates danger from flying particles of the broken test piece.

Few unique problems are involved in making car wheel patterns. Wood customarily is employed as such patterns have the advantage of being light in weight and less expensive than metal patterns. However, they have a tendency to warp and they are not so long lived as the metal patterns. The first of these objections partially is overcome by allowing the pattern blank to season for at least five months after it is glued before finishing. As the lumber employed is well seasoned before it is made up, there is little danger from warping after the blanks have aged through the required period of time. Every blank is dated as soon as it is glued so that no mistake can be made in using it too soon. One of these blanks is shown in Fig. 12. The outer rim and flange as well as in the center on the cope side, or front plate which does not have brackets, is mahogany. Hard wood is used in these places because they receive more severe usage than the tread which is against the chiller in the mold.

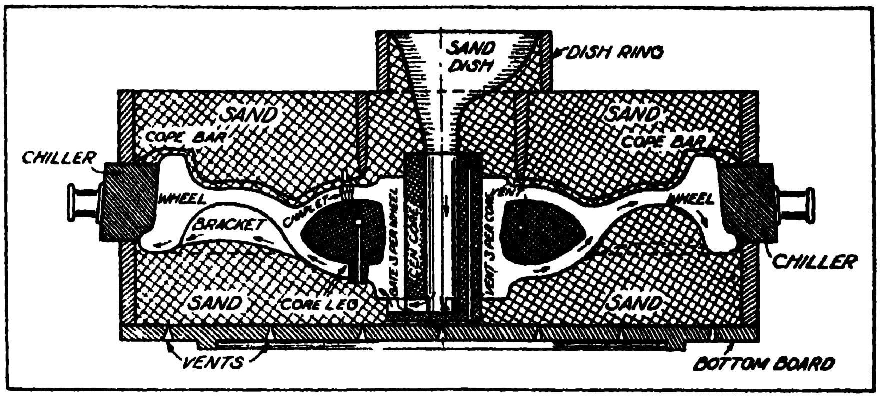


FIG. 14 SECTION OF A WHEEL MOLD SHOWING THE RUNNER THROUGH THE CENTER CORE AND THE METHOD OF BOTTOM GATING

FIG. 13—TESTS INDICATE THE DEPTH OF CHILL THE IRON WILL GIVE IN THE WHEEL NOTE THE HEAVIER CHILL IN THE BLOCK TO THE RIGHT

The life of the pattern sometimes is increased by the use of brass segments, screwed on the edge around the circumference of the flange. The portions of the pattern forming the wheel brackets are made either of wood or metal. The metal usually is aluminum, but brass segments also are employed. This will be described in detail later in the article. The front and tread of a finished wood pattern is shown at the left in Fig. 12. The small piece in the center is the core print for the center core The long narrow groove, shown in the tread to the left, and another one on the opposite side of the tread are used as hand holes for drawing the pattern.

Patterns for railroad car wheels are fairly well standardized and a great many castings ordinarily are requisitioned from one pattern. However, only a few castings are ordered off of a pattern for small miscellaneous wheels. The main difference in the small wheel pattern commonly is a variation of flange or rim size. For this reason, it is more economical to make the body of the pattern in one piece and apply a loose rim and flange to mold the wheel ordered. In this way only a few body patterns are required, but each one has a number of flanges and rims which can be fastened to it to make it meet the requirements of the customer. One of these body patterns, with a flange and a rim is shown in Fig. 11. A sheet-iron parting may be seen between the spokes. This parting is so thin that the sag in the sand closes the space of the parting when the mold is put together. It serves as a backing to ram the sand against in place of a follow board.

The formation of a chilled iron car wheel may be understood from Figs. 14 and 15 The portion around the center core is the hub. Extending from this around the ring core are

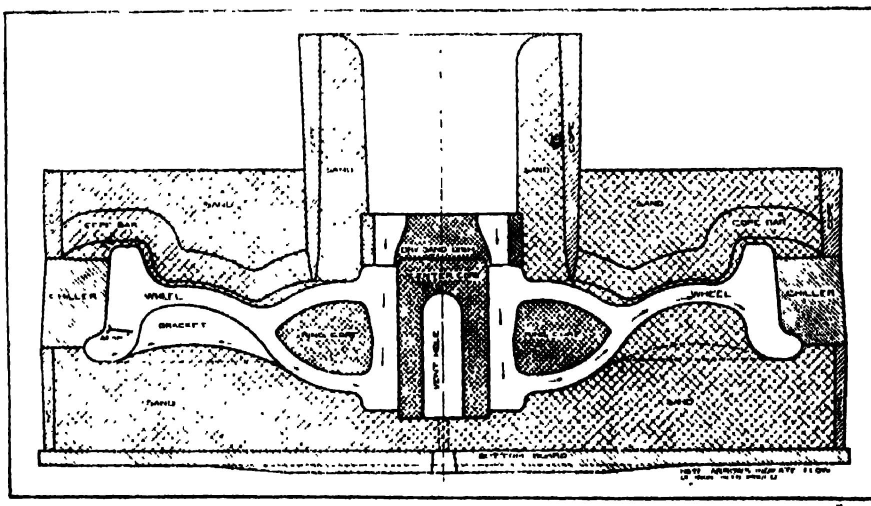


FIG. 15—MANY FOUNDRIES POUR THE WHEELS THROUGH TWO OR THREE GATES IN THE HUB—THE ARROWS INDICATE THE DIRECTION OF FLOW OF THE METAL

the front and back plates. The front plate is on the upper side and contains the chaplets. The back plate contains the vent holes made by the *toes* of the core. These double plates are merged into the single plate which is supported by brackets. The flange is the lower portion next to the chiller. Above this and also against the chiller is the tread. The rim is at the extreme end to the front of the wheel.

The two styles of gating employed are also indicated in these two figures. In the method indicated in Fig. 15 the molds are poured through a dry-sand dish core and the metal is run into the mold at the top of the hub, flowing to the bottom of the hub, out through the brackets and back plate to the flange and rim. At the same time it rises in the mold and fills the front plate, single plate, tread and rim, and finally the central riser. Either two or three gates are made in the dish core.

In the other style of gating, the mold is poured through a central core and is gated with either two or three openings, to the bottom of the hub. In this case only two cores are required, while with the former method three cores are necessary.

None of the three cores which enter into the molding of the chilled iron car wheel is complicated. The dry-sand dish core is simple and easily made on a squeezer machine. The center core is a cylindrical piece commonly vented with three vents. The ring core is the most difficult to make. It is vented through the three prints. These prints are known as toes or legs to the wheel foundryman.

A sharp coarse sand, mixed with some molding sand which has a clay binder generally is used for the ring core. One formula for this is: 12 parts new river sand, 6 parts old sand and 12 parts molding sand. The center core must not be as strong as the ring core, but must be free venting. It frequently is made of river sand and old core sand. The dish core is made of a strong sand and the mixture frequently contains molding sand. Oil binders are not used for any of these cores. Flour commonly is used as a binder, but other dry binders and some water-soluble binders are often employed.

The ring core, which forms the hollow between the front and back plates previously described is the most difficult of the car wheel cores to produce. Several ingenious devices are used in making this core. A flat plate is provided upon the core bench. This plate has three vertical rods. The pan-shaped metal corebox formed to the contour of the lower half of the ring core and with three hollow legs or *toes* which make the prints supporting the core in the mold is set upon the plate. The vertical rods on the plate previously mentioned enter holes in the three hollow toes and extend upward slightly higher than the level of the upper edge of the corebox, or somewhat more than half way through the core which is being made.

With the pan in place, sand is thrown into the pan or corebox and pressed in with the hands. Frequently only a layer of sand is thus placed and then a trough is hollowed out to be filled with cinders or coke. Wire reinforcing seldom is used where it is possible to avoid it, because of the added expense of handling, placing and removing the wires. When the first sand has been placed, and the center filling of coke or cinders is in place, sand is heaped on the pan and the upper surface swept to conform to the desired outline of the core.

The sweep used is shown at the extreme left in Fig. 17. It is pivoted at the center, and rests upon the rim of the corebox. As the sweep is rotated about the center the coremaker throws more sand on the top, and as this is brushed over the surface, all irregularities are smoothed. The sweeping operation is shown in Fig. 17. Directly at the left of the coremaker is a box of cinders; further to the left is a pan partially filled with sand and ready for the layer of cinders; while a finished core is shown leaning against the sand

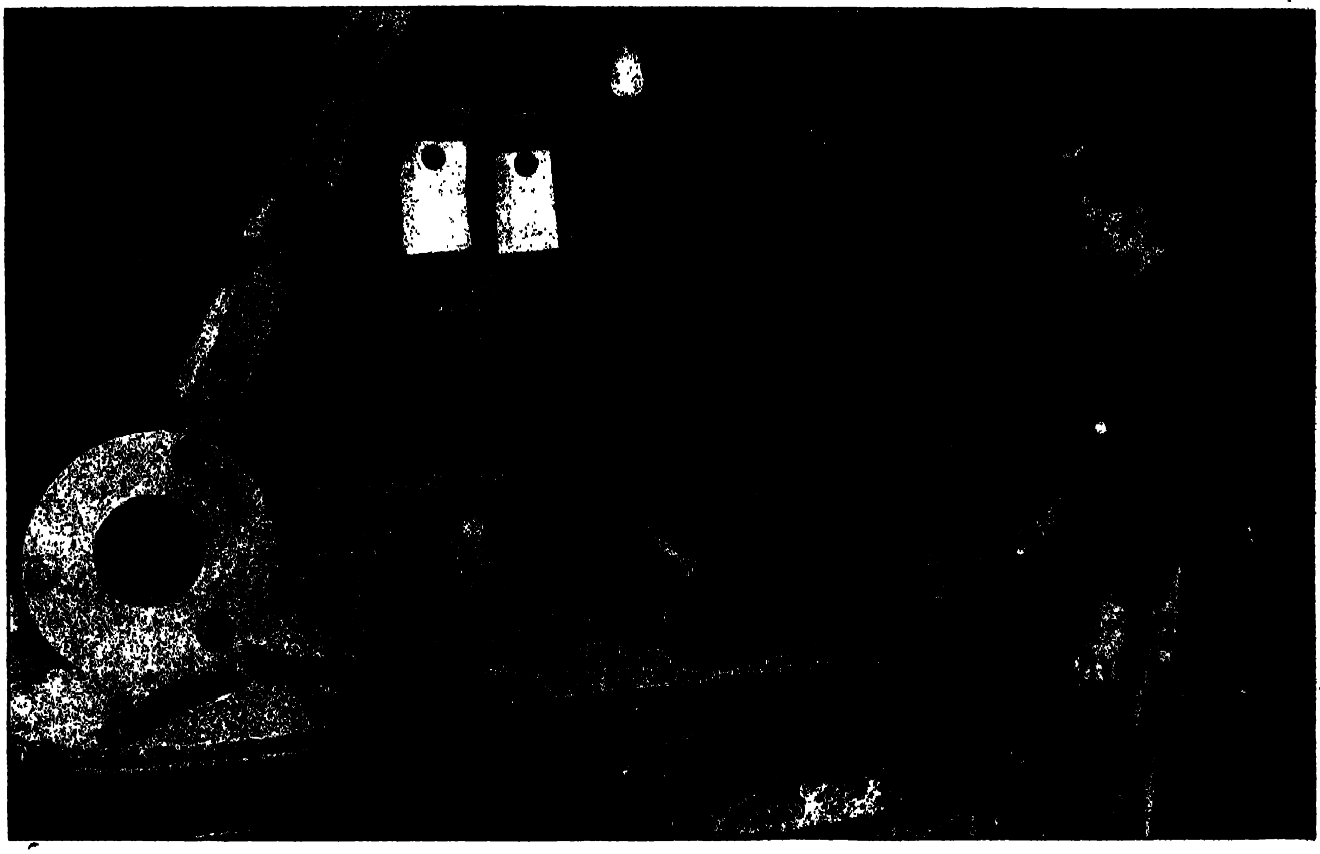


FIG. 16—THE RING CORE IS MADE WITH A SWEEP—SOMETIMES THE CENTER OF THE CORE IS FILLED WITH CINDERS TO ASSIST IN VENTING

bin at the extreme left. The vent holes are visible in the toes, or prints of this core.

Occasionally the quality of sand which is available will not produce a core which is strong enough to withstand the rush and pressure of the metal. In this case wires are used. The ring core must be strong, and at the same time must burn out quickly so that it will weaken and crumble when the metal contracts upon setting.

Effect of Sulphur in Steel

THE bureau of standards recently sent Henry S. Rawdon to England and France to secure opinions, data and available statistics on limits for sulphur and phosphorus in specifications for carbon steels. This information was desired in connection with the general investigation on the subject now being carried on at the bureau.

As a result of this visit little data strictly applicable to the bureau's research on sulphur and phosphorus in steel was obtainable in either England or France. This is largely accounted for by the basis used abroad in drawing up specifications. Specifications in England and France are based almost entirely on physical properties and little regard is paid to the chemical composition in the specifications.

In his summary Mr. Rawdon says that a research conducted along exactly the same lines as that of the bureau is now being carried out by the British Engineering Standards association to determine the effect of sulphur upon a certain type of steel products.

The much-used tension test should be regarded as only a start in the mechanical testing necessary for determining the effect of varying amounts of sulphur and phosphorus upon steels. Dynamic tests should be given full consideration as well as tests which will show the properties of the metal in a transverse as well as in the longitudinal direction, as in the tension test as ordinarily carried out.

The necessity of extensive service tests was emphasized, since no matter how many laboratory tests are carried out there is no way of interpreting such tests in terms of ordinary service.

The opinions expressed by manufacturing metallurgists differ very widely as to permissible limits for sulphur, diametrically opposing views being taken.

Regarding the method for obtaining suitable sulphur and phosphorus contents in experimental heats to be made, the general opinion appeared to be that the additions should be made during the heat and not at its close. The general opinion was held regarding the subject of *residual* vs. *added* sulphur that the difference consisted largely in the physical condition of the two and no clear, definite expression of opinion could be obtained as to the possible detrimental effect of some obscure condition accompanying high percentages of sulphur and phosphorus.

The general tendency of the English railways is to revert to the prewar specifications for ordering materials but no such generalization can be made regarding French practice.

Piston and Piston Ring Castings

By H. E. Diller

Question—We are manufacturing pistons and piston rings, and have trouble with gas holes. Our mixture consists of 30 per cent pig iron, 35 per cent home scrap and sprues, and 35 per cent foreign scrap, principally automobile parts. The pig iron contains 3.30 per cent silicon, less than 0.05 per cent sulphur, 0.90 per cent phosphorus, and 0.70 per cent manganese. Could you suggest another mixture more suitable for the work?

Answer—Pin holes may not be due to the mixture but to oxidized iron or too wet molding sand. The latter difficulty could be remedied by using a freer venting sand and dampening it less. Oxidation is caused by an excess of air in the cupola. To prevent this, care should be taken to have a bed of coke which will extend approximately 30 inches above the top of the tuyeres. Then enough coke should be added to each charge to maintain the level of the melting zone at the same height. About 8 parts of iron to 1 part of coke is the general practice, but some foundries run their melting ratio as high as 10 to 1. On the other hand, occasional shops have a melting ratio as low as 6 to 1. This ratio will be largely dependent upon melting practice.

Entirely different mixtures should be used for iron for pistons and for piston rings. A low-phosphorus iron with phosphorus about 0.20 per cent is advisable for making pistons. Such an iron will shrink less than a higher phosphorus iron and therefore pistons made from it will be freer from honeycombed sections. Sulphur should be kept below 0.10 per cent. Silicon may range from 1.75 to 2 per cent, and between 0.50 and 0.80 per cent manganese is desirable. A good mixture for pistons is 10 to 15 per cent steel scrap, 30 to 40 per cent home gray-iron scrap, and the remainder pig iron of an analysis to give an iron of the composition here suggested.

The properties desired in piston ring metal are altogether different from those required for piston iron. Piston rings require a stiff metal and high strength is not necessary, the idea being that the piston ring should maintain its shape under all working conditions. Phosphorus and silicon should be higher in this iron than in the iron used for pistons. The phosphorus should be approximately 0.80 per cent and the silicon should range between 2 and 2.50 per cent. The sulphur and manganese should be the same in piston ring iron as has been mentioned for piston iron.

Foreign scrap is not advisable for piston rings unless it comes from a source where its composition will be uniform without question throughout the entire shipment. This is imperative as the spring in each piston ring must be approximately the same or the ring will be eccentric as it comes from the peaning machine unless this is regulated to suit each lot of rings. This of course would be undesirable and unprofitable.

Remodeling Foundry

The Griffith Foundry Co., Griffith, Ind., recently has been organized and has taken over the buildings of the Griffith Manufacturing & Supply Co. It is having these buildings remodeled to suit the needs of a foundry and will start operations shortly. The new company is capitalized at $150,000. The following officers have been elected: Harry C. Stuart, president; Frank C. Wackewicz, vice president; Coit F. Holt, secretary-treasurer. The board of directors is composed of these officers with S. E. Stuart and J. C. Nowicki.

The Alloy Electric Steel Casting Co., Massillon, O., has accepted a 5-acre site at Warren, O., and will soon begin the construction of a foundry. The land was offered to the company by the Warren board of trade without cost as an inducement for the establishment of the plant in Warren. Officers of the company, which is backed by Massillon capital, are: President and general manager, N. L. Coxey; vice president, A. T. Ranck; secretary and treasurer, J. S. Corey, Jr

Accelerating Cylinder Production

Attention to Minute Detail and the Adoption of Every Mechanical Aid to Speed and Accuracy Have Increased the Output of Automobile Cylinders in Wisconsin Plant

LESS than a year ago, when automobile manufacturers heralded the first advance of orders that recently has swamped the foundries of the country, castings could be secured at will. Practically without exception all of the automative industries either had their own shops, or patronized a number of independent foundries which were under contract to deliver a stated number of castings, as needed throughout the year. If more were needed, a mere hint brought scores of offers from foundries which were endeavoring to maintain operation under the slack times which followed the armistice. Less than a year ago these strange conditions governed throughout the country.

Today automobile castings of all classes are practically unobtainable for early delivery. Special representatives of the manufacturers are journeying throughout the territory contributary to the automobile centers, seeking shops which have a small amount of unused capacity that can be turned to making even a few automobile castings per day to supply the shortage.

Self Contained Plants Expand

Those establishments which maintain their own foundries are seldom more fortunate than those which have depended solely upon outside shops for their castings. The expansion in the automobile business has been so great and so rapid that even self-contained manufacturing plants have outgrown their facilities and must seek elsewhere for badly needed castings.

Under all these strenuous trials, every conceivable means is exerted to attain greater output. Probably no single branch of the foundry industry has been developed to as high a plane of efficiency as has that division which is engaged in automobile castings production. Association with the industry which has stood for repetition work, large output, straight line operations, simplicity in design and those many factors which go to make up stupendous production, has rendered the shops making

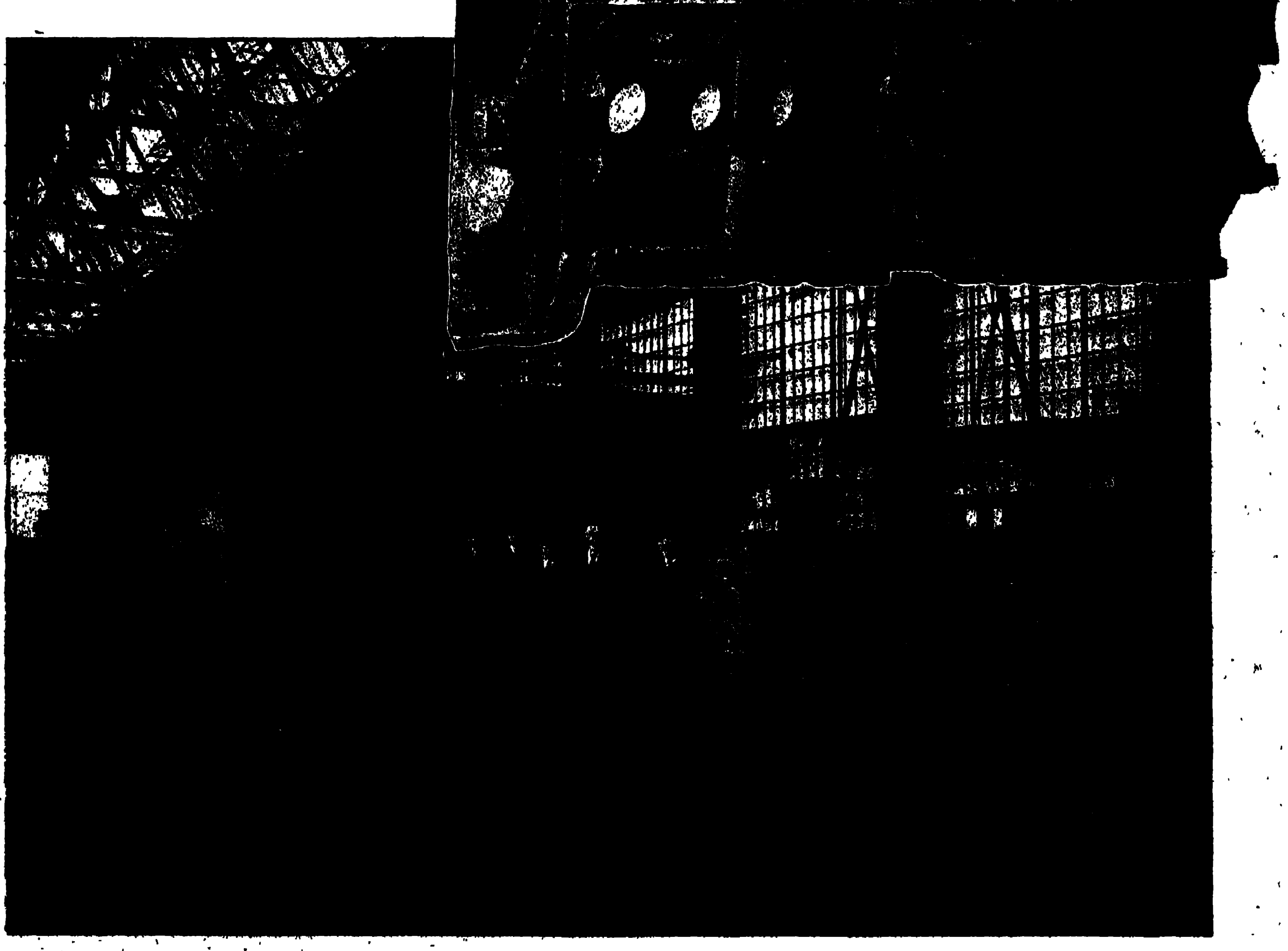


FIG. 1—FLOOR OF COMPLETED CYLINDER CORES READY AT EVENING TO GO INTO THE MOLDS ON THE FOLLOWING DAY—THE OPERATING EXECUTIVES, FROM LEFT TO RIGHT, ARE W. H. GOLDSTINE, MANAGER; LOUIS RASMUSSEN, SUPERINTENDENT; CHARLES WUSSOW, CUPOLA FOREMAN; CHARLES LEISS, FOUNDRY FOREMAN; AND DAVID FRANCIS, COREROOM FOREMAN FIG. 2—THE CYLINDER CASTING WITH GATES AND RUNNERS IN THE POSITION WHICH THEY OCCUPY IN THE MOLD

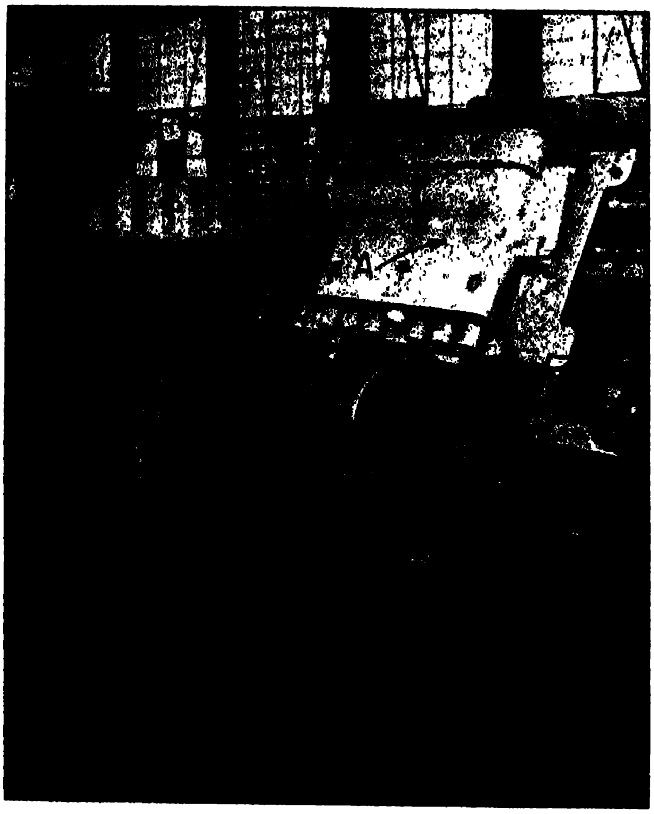


FIG. 3—COPE PATTERN MOUNTED FOR MOLDING

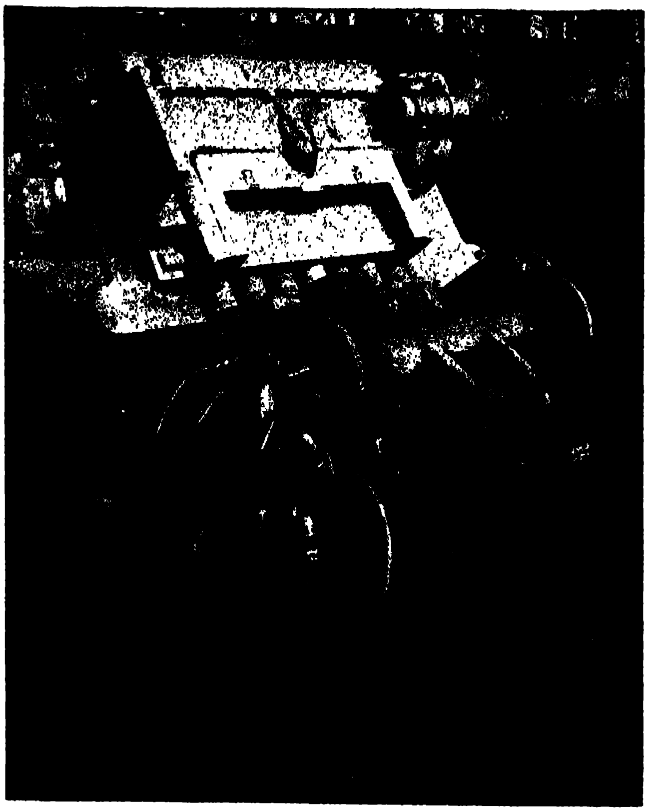
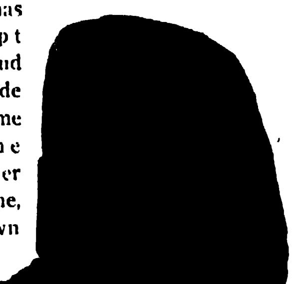


FIG 4—DRAG MACHINE WITH COMPLETE PATTERN

automobile castings leaders in efficiency. Therefore, the attainment of still higher perfection and greater production with the retention of quality has marked a new step in the advancement of foundry practice.

In Kenosha, Wis., a short ride north of Chicago, is the Nash Motors Co., manufacturer of passenger automobiles and the Nash Quad, the latter known through its service during the war. The company has a large, modern and well equipped foundry. It produces practically all of its own castings and has done so continuously except when the exceptional demand for cars and trucks has made it necessary to farm out some of the work. Recently the foundry has been placed under new management, W. H. Goldstine, a man who has practically grown up with the cast-



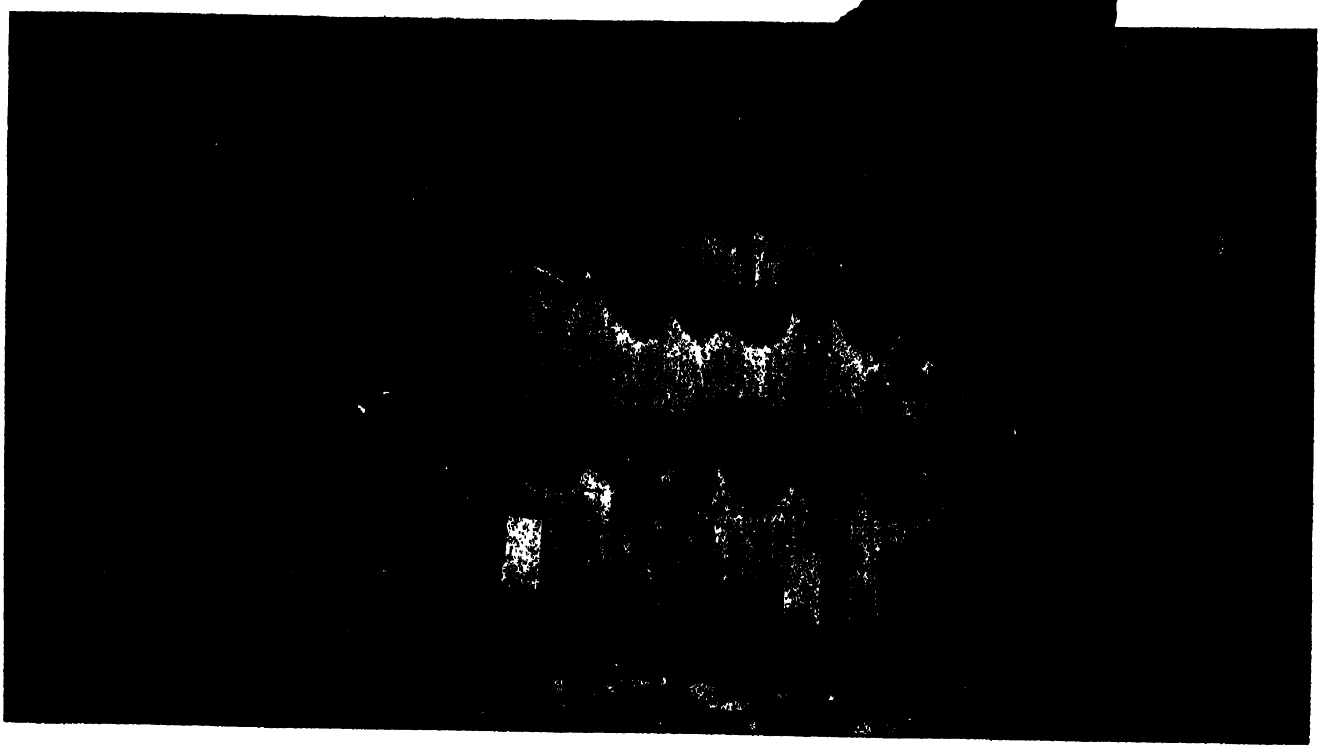


FIG. 5—FLOOR OF DRAG MOLDS AT THE START OF CORING OPERATIONS—NOTE THE ONLY OPERATION PERFORMED TO THE JIG IN PUTTING THE CORES IN PLACE

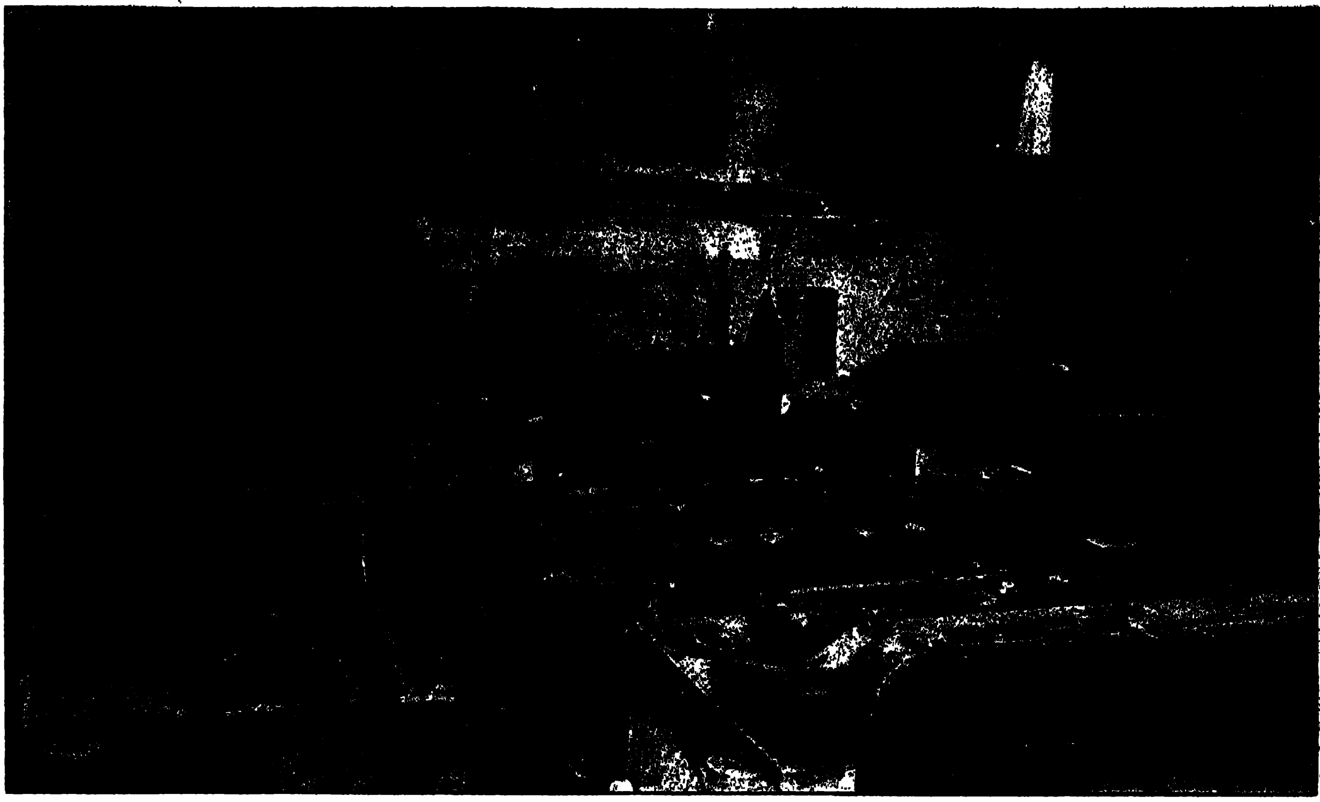


FIG. 6—SUCCESSIVE STAGES IN SETTING CORES AND PREPARING TO CLOSE THE MOLD

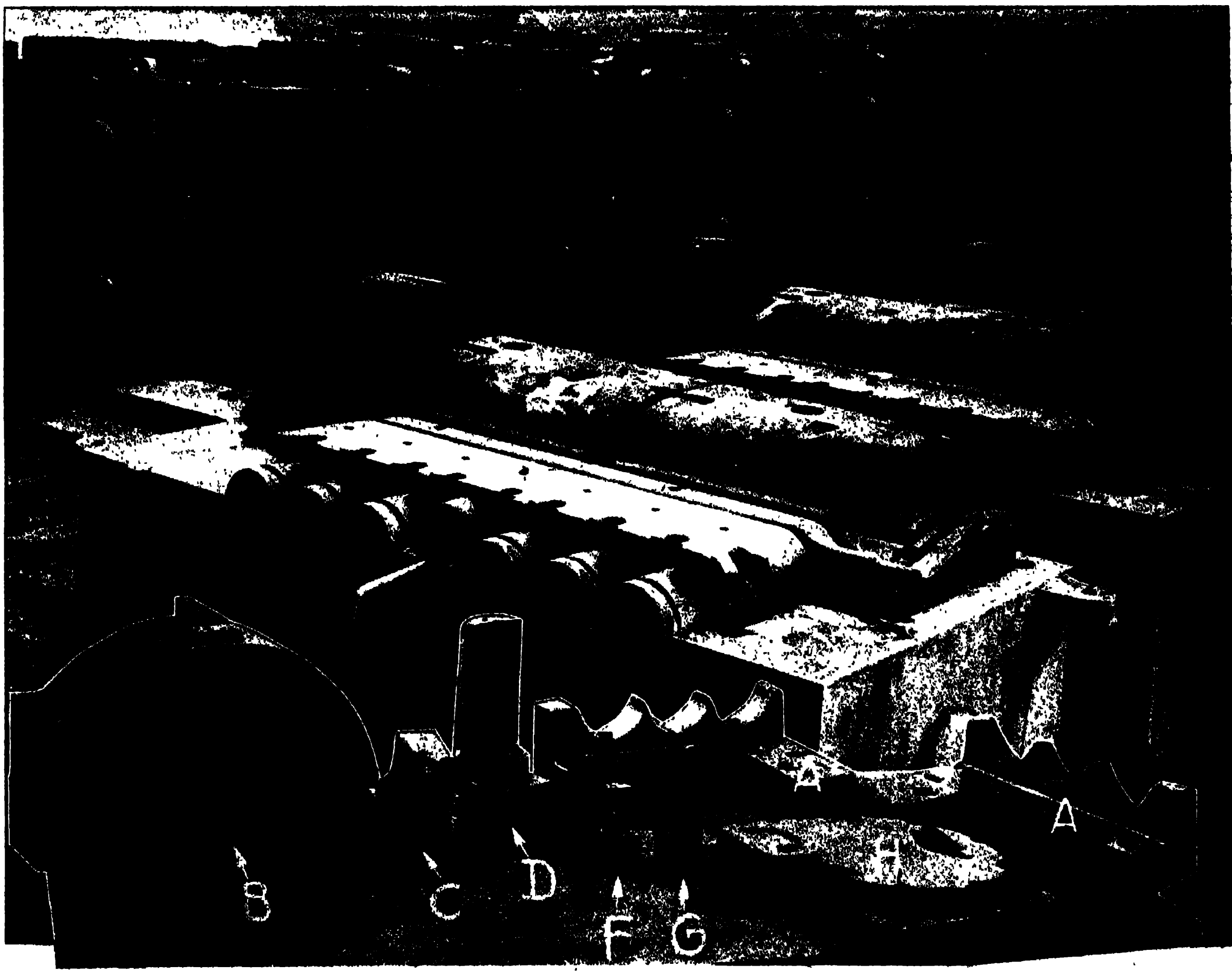


FIG. 7—FLOOR OF MOLDS READY TO RECEIVE THE COPES—NOTE THE SIMPLE CLAMPING AND THE RUNNER BOXES MADE READY IN THE BACKGROUND
FIG. 8—INSET—SMALL CORES WHICH ENTER THE CYLINDER MOLDS

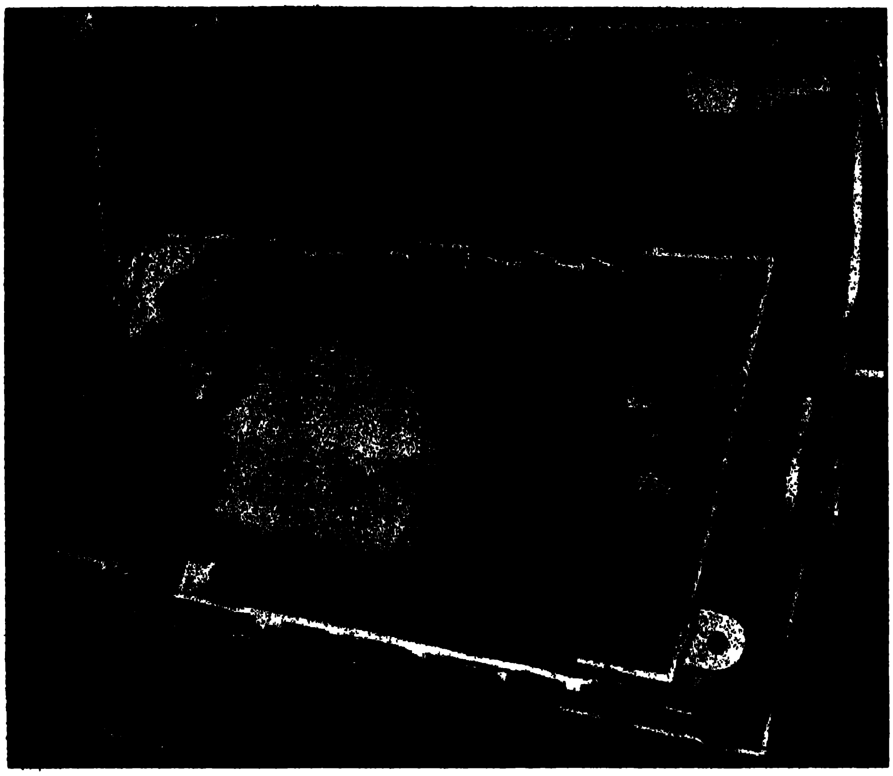


FIG. 9—COMPLETED COPE WITH RIG FOR TURNING AND HANDLING THE MOLD IN CLOSING—NOTE THE CRUSHING AND CHAPLET CORES USED

ings end of the automobile business was made foundry manager. Louis Ramussen, who also is well versed in this particular branch of the industry, was made superintendent and together these men have built up an organization which constantly has improved the practice of the shop, with the result that were it not for the growth in demand for the automobile built by the company, all of the foundry work required could be handled within its own shops.

A comparison by figures alone does not measure all the improvement which has been brought about in the foundry, but indicates the growth in production through efficient methods. Output on one type, 6-cylinder block, for passenger cars has been increased from 140 to 300 per day. Transmission housings now are produced at the rate of over 200 per day, where 125 were produced previously. Cylinder heads have been increased from 130 to 300 and manifolds from 130 to 300. Placid contentment with existing conditions has not followed this growth in production. The management constantly is seeking greater output, not through increased human effort, but rather through perfecting methods, attaining accuracy, and bettering the entire shop efficiency.

The molding practice followed in making the cylinder block mentioned gives an idea of the infinite care in detail which is expended, and the perfection of the system which is in operation. The cylinders are made on four floors, which extend at right angles to one side of the main concrete-floored aisle. Molding machines are placed at each end of each of these floors. Eight molding machines produce molds for 300 castings per day.

The drag machine of each unit is placed at one end of the floor and the cope machine at the opposite end, while between each two successive floors is a crane runway with traveling air-operated hoists, serving either to the left or right. One of the drag machines with the pattern mounted is shown in Fig. 4. Special flasks are provided, which are machined to jigs. These have permanent trunnions at each end, by which they are lifted and turned when held in the special yoke shown in Fig. 9. At opposite corners on each flask are lugs that are drilled to admit guide pins used to locate the cope in closing. One side of each flask is provided with semicircular depressions through which the six prints of the cylinder cores and a single waterjacket core print may project. The back is hollowed out so that the bottom of the combined cylinder-crankcase core may project through and rest on the edge of the flask. An improvement in this flask is contemplated, involving the use of an offset or false side of the flask, extending from a few inches below the depression upon which the core rests, up to and several inches above the joint between the lower and upper halves of the crankcase core. This will provide a space between the cores and the false side, into which sand may be rammed to prevent any possibility of a runout. The cope flask is similar in every respect to that used for the drag.

A long support core to hold the ends of the cylinders and crushing cores to hold the flywheel and timing gear housing cores are set into place on the pattern and rammed into position with the drag. The drags are taken from the machine and placed in long rows which extend the entire length of the molding floor. Gasoline then is poured into the mold and fired to ef-

FIG. 10—JIG FOR RUBBING THE HALF-SECTION CYLINDER CORES—NOTE THE REMOVABLE BANDS ON THE SUPPORTING SIDES OF THE JIG

fect a skin-drying of the mold surface. Cores then are placed in position.

In this shop every attention is given to attaining accuracy in the cores before they are brought to the molding floor. Further, as many cores as it is possible to assemble in the core room, are placed together, so that the time and labor of placing cores on the molding floor is conserved. This item produces a large saving as a great part of the cylinder casting is carried in cores which are complicated and must be extremely accurate. The main barrel core, which forms the hollow interior of the cylinders, and the upper half of the crank case is assembled together with the waterjacket cores on a special platform, such as those shown in Fig. 13. In this way the main large unit may be lifted and set into the drag in one piece, and the only check upon dimension which is performed upon the cores when assembled in the mold is to try the position of this large assembled unit with the gage which is shown at *A* in Fig. 6. Immediately in front of this gage are shown two lifting bars, such as are used to pick up the cores from the carrying platform to lower them into place in the drag. The projecting pins engage holes in the core, four of which are provided at the back and four others in the ends of the cylinder prints.

In addition to the assembled barrel and water-jacket core mentioned, eight other cores are set into the drag. These include the valve chamber cores, *A*, Fig. 8, which are made in two sections as shown. The starter-box core, *D*, Fig. 8, is set at the flywheel end of the mold. Next to this is the flywheel housing core, *B*, which is supported on a crushing core in the drag. At the opposite end of the mold the gear case core, *H*, is set in place. An extension of this core has a small groove into which rests the projecting print at one end of the waterjacket core. The opposite end of the latter is supported on an extension of the crushing core which is rammed up with the mold to support the prints of the cylinder cores. The waterjacket core is supported on four bearings. The small cores, *F* and *G*, are the oiler core and gear neck core, respectively. A number of small chaplets, similar to those which are visible in Fig. 7, are used both under and on top of the cores to prevent any possible shifting when the metal is poured.

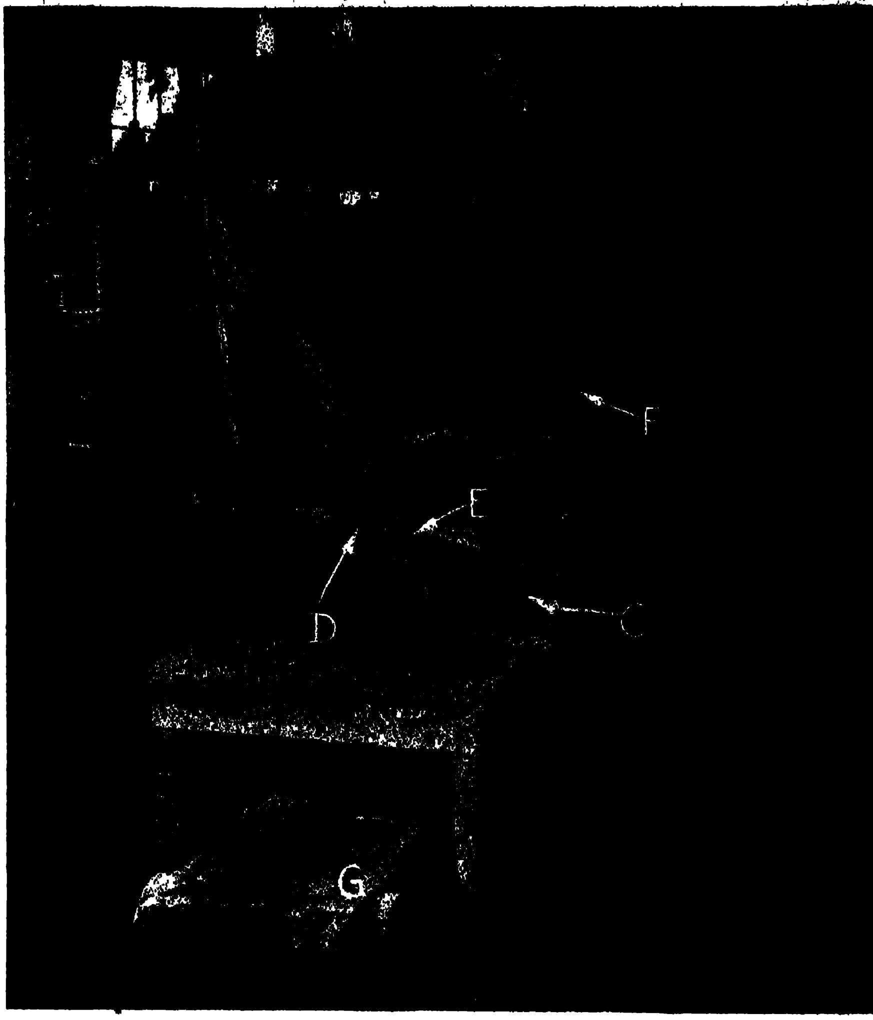


FIG. 12—ASSEMBLY BENCH WHERE THE CYLINDER CORES ARE BUILT UP ON TRUCKS AND CLAMPED PREPARATORY TO FINAL BAKING

After all of the cores are in position a slurry of fire clay is applied as shown in Fig. 6 to effect a tight joint when the cope is lowered into place.

The cope machine with the pattern mounted is shown in Fig. 3. The tiny holes shown at *A* in this illustration accommodate pins which are set into small cores. These pins serve a double purpose. They hold the cores firmly in position while the cope is molded, and establish a definite location for two chaplets. The two small cores,

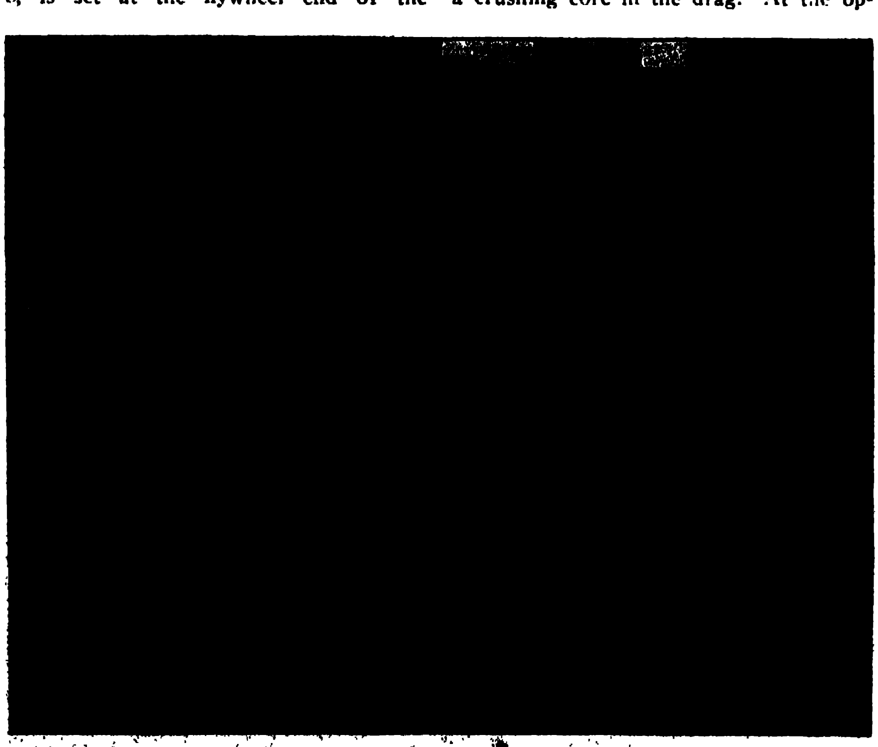


FIG. 11—THE HALF-SECTION CYLINDER CORES ARE BLACKED BY SPRAYING OVER A TANK

shown near the two ends of the mold, form depressions in the cylinder where holes are later machined. The core at the center, which also is shown supported upon the edge of the mold at the left forms a boss in the center of the casting. The small dowels at the upper side of the cope pattern, Fig. 3, serve to locate gate pins which are set when the mold is rammed.

The method of gating the cylinder mold is apparent from Fig. 2, which shows the casting in the position that it occupies in the mold. Two runner boxes connect to two main sprues which run straight down through the cope, through both sections of the base of the crankcase core and to two runners at the bottom. These runners are carried in the bottom portion of the crankcase core. Each communicates through seven separate flat gates formed in the drag, to the bottom of the casting. The only strainers used are in the runner boxes. These are flat cores, rectangular in outline conforming to the bottom of the runner box, with one half formed solid and the other perforated. The metal is poured upon the solid portion of the strainer core, which is on a slightly lower level than the end which is perforated. In this manner the entering stream strikes the flat core, flows up and through the strainer which breaks up the stream into a spray that falls through the long sprue to the runners at the base. No additional risers are provided, as the weight of metal in the sprues provides adequate feeding.

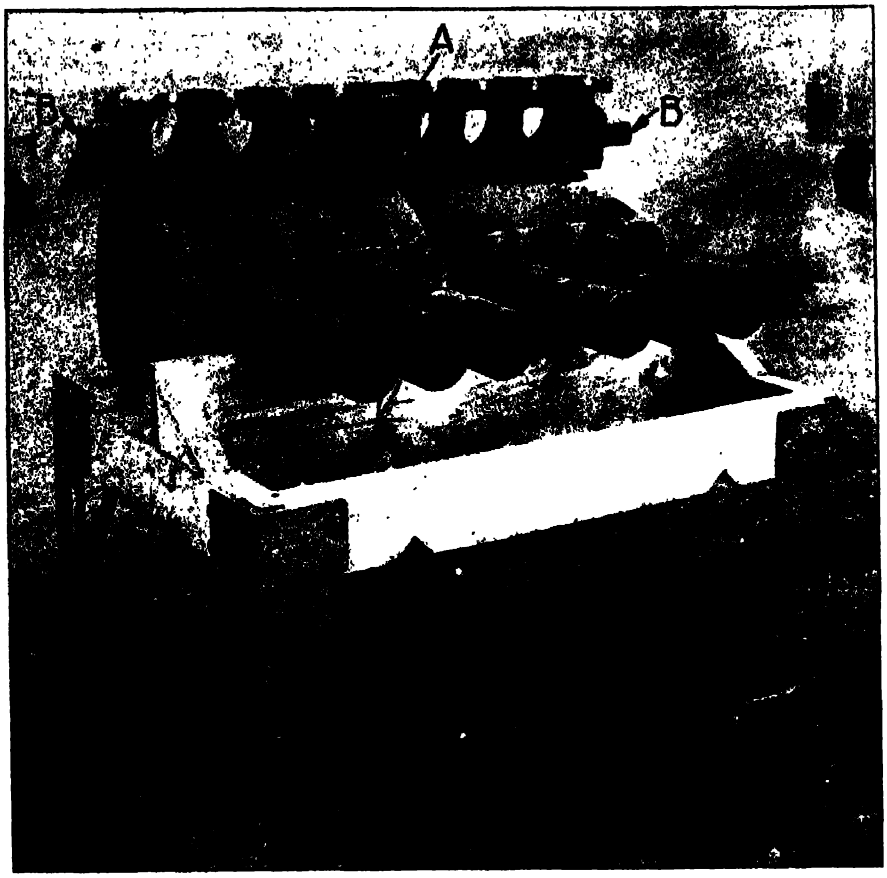


FIG. 13—CYLINDER CORE READY FOR FINAL ASSEMBLY WITH WATERJACKET CORE BEFORE BEING CARRIED TO THE MOLD

As was stated previously, the admirable system followed in making and assembling the cores saves a great deal of time on the molding floor. In the large core department which is maintained to supply the needs of this establishment, every minute detail is studied in the effort to better production or accuracy. It has been found that a 63 per cent loss could be reduced to less than 8 per cent through proper cores. In the machines used in producing the half section of the combined cylinder-crankcase core, three loose pieces, including a gate stick, are set into the corebox. A mixture of Michigan City sand with core oil made by the Holland Core Oil Co., Chicago, is used for these cores. The half section cores are baked flat on perforated plates. Two batteries of 10 ovens each are devoted to core baking in this foundry. These all are coke fired with forced draft.

After the half cylinder-crankcase cores are baked they are carefully tried in jigs, and rubbed to an accurate fit. The rapid and efficient rig used for this operation is shown in Fig. 10. The cores are placed, flat side up, in the jig as shown. They are supported at three points and the distance between these three points of contact and the upper surface of the jig is accurately maintained. Gages are applied to these rubbing boxes each morning to assure this accuracy. With the core section in place as shown, a rasp file is drawn rapidly down the three half-cylinder columns to form the grooves which may be noted in the upright core at the right. These grooves serve as vents and further when assembled they afford sockets into which pins of the lifting bars are inserted in lifting the cores from the delivery benches to the molds. When the grooves are formed, the rubbing bar, shown at *B*, is dragged across the core, resting upon the two sides of the jig. This operation which is quickly performed assures the accurate fit, or interchangeability of the half sections. The sides of the jig which support the scraping bar are provided with tolerance strips, screwed to the jig. When the master gage shows that these have worn unduly, they are removed and new strips are screwed in place.

Cores Blackened

The half sections then are carried, four together, to the blacking trough which is nearby. There they are stood on end on two supporting boards over a tank of blacking. A cup to which an atomizing device is attached is used to dip the blacking from the tank. The cores are sprayed in succession, the front one being lifted away as soon as it is covered with the blacking material. From this point the sections are carried to a bench where they are pasted together.

In this operation one section is laid with the flat surface turned up and smeared with a mixture either of three parts flour and one part dextrine, or with a special core paste. The top section then is applied and pressed firmly in place. A clamp with a set screw adjustment is used on the base of the core. This is shown at *C* in Fig. 12.

The two newly pasted halves then are set perpendicularly on small four-wheeled assembly trucks at one end of the bench shown in Fig. 12. The tops of the cylinders are wired firmly and then the truck is moved along the bench. Next the cam-bearing cores are set in and clamped in place by the special rig with set screw adjustment, shown at *D* in Fig. 12. The gage used to try the position of the cam bearing cores is shown at *F*. Small spacers are inserted to assure the proper maintenance of the opening at the point indicated at *E*. As these operations are performed the truck has been moved along on the bench trackway, until when the

assembly is complete, the core is lifted and laid upon its side on a rack similar to that shown in the foreground. These racks support the cores at three points, obviating danger of sagging or warping when they are rebaked. They further permit a number of the cores to be stacked upon one core-oven truck or platform for baking. In this manner space is conserved and the free circulation of drying air around the core is not restricted. Fifteen of these racks are placed together upon special platforms, which are picked up by electric lift trucks and carried into and out of the core ovens. A number assembled for the ovens are shown in Fig. 1.

As soon as the core is removed to one of the racks, the small assembly truck, *G*, Fig. 12, is lifted to the lower trackway and given a shove to return it to the other end of the bench ready for reuse.

Two gangs of two men each assemble the cylinder-crankcase cores ready for the second baking. With the simple rig described, these six men assemble 600 sections or 300 complete 6-cylinder cores each day. The cost of the labor in finishing these cylinder cores is about 3¼c. The work is so planned that 125 or more complete cores are ready to be carried to the molds by 4:30 o'clock in the afternoon preceding the day in which they are to be used. More than sufficient additional cores have been put in the ovens for the final baking at closing time, so that the following day the final assembly is well in advance of the molders' needs.

The waterjacket cores, which are assembled with the barrel core previous to delivery to the molding floor, are made in two pieces, as may be noted from a close inspection of Fig. 13. These are turned out on special plates which have saddles to support the cores while they are dried. The upper portion of the waterjacket core has two end projections or hubs which rest upon drag cores and serve to support and also to vent the former. These are indicated at *B*, Fig. 15. Another vent is provided through the print *A*. When the complete core is set into the mold, a rod is thrust into this vent and the joint around the print is luted with fireclay before the mold is closed. This may be noted in the first mold in Fig. 7.

When the two parts of the waterjacket core have been baked, they are rubbed in special jigs to form an accurate joint and then are pasted and rebaked as in the case of the cylinder sections. The two sections of the barrel core, with the complete waterjacket core are shown in Fig. 13. The waterjacket core is slipped into place over the ends of the cylinders and left upon assembly racks until needed, when an electric truck lifts the platform and conveys it along the main aisle to the runway between two of the waiting lines of drag molds. Here the core-setters receive and carry the core platform or table along side the mold and lift the core in place. This method of handling has reduced the loss due to breakage in handling to an absolute minimum.

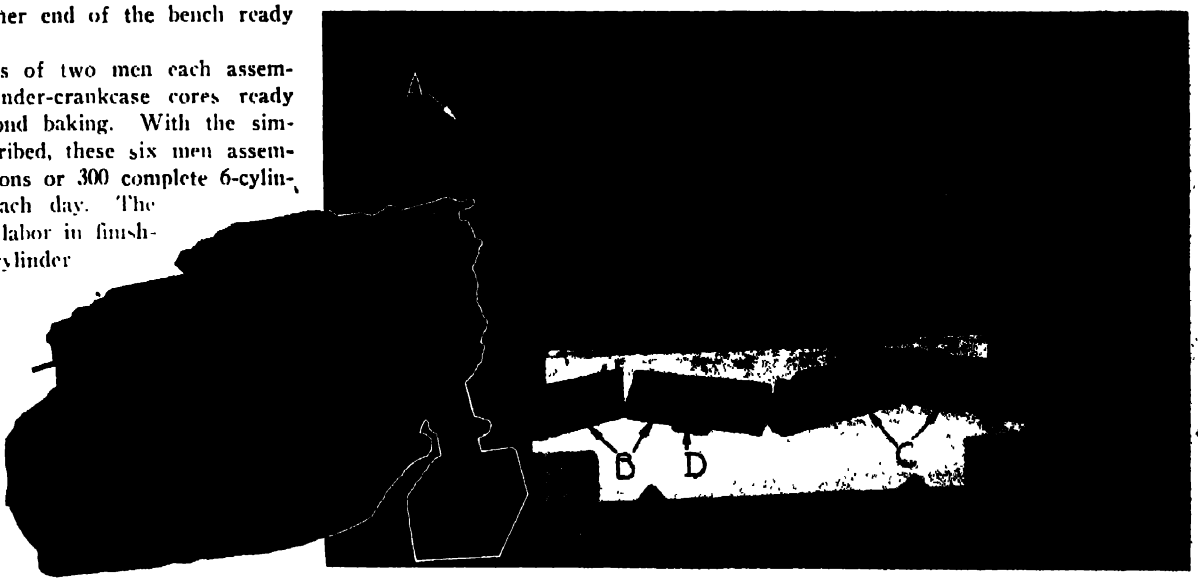


FIG. 14 CYLINDER HEAD CASTING INVERTED TO SHOW THE METHOD OF GATING

FIG. 15 VARIOUS CORES WHICH ARE USED TO MAKE UP THE INTERIOR AND UNDER SURFACE OF THE CYLINDER HEAD CASTING

Obviously the core sand supply plays a prominent part in maintaining the quantity and quality of the work produced. A yard traveling crane delivers core sand into hoppers, each of which hold 30 tons. These hoppers are lined with a liberal supply of steam pipes so that when the sand is ready for use it has been dried to a consistency which will receive the mixture of core oil and water employed. The material is taken from the hoppers into a dump bottom car and then is elevated to the mixing machines. Two Blystone and one Standard mixing machines which together have a capacity of 110 tons per day are employed. The core room is served by a 60-foot traveling crane which conveys all core sand from the mixers to the benches. Bottom dump buckets permit the material to be dropped directly into bins at the benches. This method of handling saves the work of eight laborers.

The production which is being maintained on the cylinder job may be appreciated from the labor figures. Piece work is employed throughout the shop, even the electric truck operators are paid 5c per lift and average 150 lifts per day on their work. Thirty-six men are employed on cylinder-core work working in 8-hour shifts. These gangs each make 1230 half-section cores. This provided 615 complete barrel cores which are assembled in pairs for use in the mold, making 300 complete cylinder-crankcase cores, providing an allowance of 15 for breakage or any possible overage in the estimated production of molds.

An equally remarkable record is noted in molding and assembling the completed molds on the cylinder work. As was noted, four floors each with two machines, a cope and a drag unit, are in use. Each of the four floors is worked by a gang of 10 men. Eight were formerly employed on each floor, two working on the drag machine, two on the cope, two setting the cores, and one acting as finisher, drying the molds, venting and luting the joints. The eighth man operated the crane serving each machine. This force produced and poured an average of 65 molds per day. The addition of two laborers to carry the cores to the side of the molds, and two other laborers to help pour increased this production to upward of 75 molds per day from each of the four floors.

The practice employed in making cylinder heads is similar to that used in many other shops. Only a small portion of the detail of the casting is carried in the mold. The core forming the inner water circulating passages is suspended by wires from a cover core which forms the under side of the cylinder head. A head casting, just as it comes from the sand, is shown in

Fig. 14. The different cores which are used are shown in Fig. 15. The inner core, top and bottom views are indicated at *A*, while the assembled cover core and inner core resting on edge is shown at the back. Below are the two parts that make up a special gate core, *B* being the bottom portion, and *C* the top. The strainer is set in place in the square hollow of *B*. One molder and five helpers produce over 185 heads per day.

Two cupolas, one lined to 60 and the other to 54 inches, produce sufficient iron for all of the automobile work which is handled in the Nash foundry. These cupolas are operated continuously, from about 10 a. m. until 6:30 p. m., and produce from 60 to 110 tons of iron per day. A mixture of malleable-bessemer pig iron with 15 to 20 per cent of charcoal iron, shop scrap and about 15 per cent of steel, is melted. The charge in the 60-inch cupola averages 2400 pounds of iron to 300 pounds of coke and in the 54-inch furnace 275 pounds of coke is used with 2000 pounds of iron. The average analysis of iron used in the cylinder work is as follows: 2.25 per cent silicon; 0.08 per cent sulphur; 0.175 to 0.2 per cent phosphorus; 0.60 to 0.75 manganese; 0.40 per cent combined and 2.80 per cent graphitic carbon.

The metal is conveyed by overhead monorail cranes from the cupola spout to pouring stands at the side of the main aisle contiguous to the different molding floors. These are operated from traveling cages which are unit with the crane trolleys. These monorail tracks are about 30 feet above the foundry floor, and are laid out in a system of loops, and straight tracks with switches so as to command the entire foundry. At one time considerable danger was entailed by the use of these monorails, particularly when the operators were running their cranes backwards. A number of accidents happened through running back into open switches. The management adopted a simple remedy for this condition. They caused all of the rails to be painted white. This renders them plainly visible at all times, so that the operator readily may see when a switch is open. One of the painted trackways is visible in the upper portion of Fig. 1. The painting is renewed on Sunday at least twice each month so that the coating is not allowed to become dingy or inconspicuous.

Chicago Will License Metal Industry

Practically all iron, steel and metal industries within the city limits of Chicago have been put under a license system by an ordnance passed recently by the city council. This is part of an effort to make up by general licenses for the deficit in revenue resulting from cessation of liquor license payments.

The first section of the ordnance follows:

"No person, firm or corporation shall conduct, operate, manage or carry on any iron, steel, brass, copper or aluminum foundry, machine shop, steel factory, iron factory, or other establishment where iron, steel, brass, copper, aluminum or other metals are made, manufactured or fabricated, within the city limits of the city of Chicago without first obtaining a license as hereinafter provided."

Application is to be made to the commissioner of health, who will investigate from the sanitary standpoint under health, safety and sanitation laws. Recommendation from the health department to the mayor results in the license being issued on payment of annual fees graduated according to the number of employes, as follows:

Employes	Fee
1-- 10	$ 25.00
11 - 25	50.00
26-- 50	60.00
51 - 75	70 00
76 --100	80.00
101 125	100.00
126--150	120 00
151--175	140.00
176- 200	160.00
201 250	180.00
251 and upward	200 00

The number of employes is to be determined by the largest number at work at any one time during the preceding year, and provision is made if a wholesale department or store is conducted by the foundry, clerks and other employes of these departments shall be included in the schedule. A penalty of $25 to $100 for each violation of this city ordinance is provided.

British Combine for Nonferrous Research

British firms engaged in the nonferrous industry have formed an association to carry on research work in nonferrous metals and alloys for the benefit of members. This organization is known as the British Nonferrous Metals Research association. It is incorporated as a limited liability company and will work without profits but will have a guarantee from members in place of shares to raise money for financing it.

Members have the right to receive scientific and technical information from the information bureau; to recommend subjects for research and investigation and to request a specific research to be undertaken for their sole benefit or for the benefit of a particular member at cost price. However, the association is not bound to grant such a request and, in granting it, may impose any conditions or restrictions deemed desirable. The members also have the privilege of using any patents or secret processes resulting from any researches undertaken, either without payment for licenses or else at only a nominal charge.

A librarian has been appointed and a beginning has been made in filing and indexing literature relating to nonferrous metals and alloys. The association will not undertake routine investigations such as can be done in works laboratories. At first the association will carry on its work through the laboratories of existing institutions, such as the universities.

New Malleable Foundry Starts Operations

Operations were started in the new malleable-iron foundry of the Moline Iron Works, Moline, Ill., the latter part of March. This plant will ultimately give employment to from 220 to 250 men, which will bring the total number of employes of the company up to between 500 and 600 persons. The foundry is housed in two buildings. The one which contains the molding department is 110 feet by 360 feet. It is equipped with two 12-ton melting furnaces. The building containing the annealing and finishing departments is 110 x 360 feet. Eight 25-ton annealing furnaces have been installed. The new foundry will produce malleable castings for agricultural implements, automobiles, trucks, tractors, washing machines and saddlery hardware.

The officers of the company are: President, L. E. Nutt; vice-president, J. J. Creedon; secretary, L. H. Dorman; treasurer, J. T. Miles. Edward Miles is foundry superintendent.

Engineering Companies Have Been United

Westinghouse, Church, Kerr & Co., Inc., New York, recently combined with Dwight P. Robinson & Co., Inc., New York, under the name of the latter firm. The new company will occupy executive offices at 61 Broadway, and engineering and designing offices in the Grand Central Palace, New York. Dwight P. Robinson, president of the new company, was for many years president of the Stone & Webster Engineering Co., New York. In 1918 he formed the company which has now consolidated with Westinghouse, Church, Kerr & Co., Inc.

Electrical Melting of Alloys - IV

Direct Arc Furnaces Which Have Won Their Position in Steelmaking Fields Have Been Successfully Adapted to Nonferrous Melting Where Volatile Alloys Are Absent

BY H. W. GILLETT

WHILE electric crucible brass furnaces are not limited as to the alloys they can handle, they are extremely limited in applicability either because of their low thermal efficiency, or of their lack of reliability. The use of some hearth-type furnace is essential. Naturally, the first type to consider is the direct arc type, which holds almost undisputed sway among electric steel furnaces, and of which the Heroult, Snyder and Greaves-Etchells are among the most prominent makes in commercial use for melting metals, throughout this country.

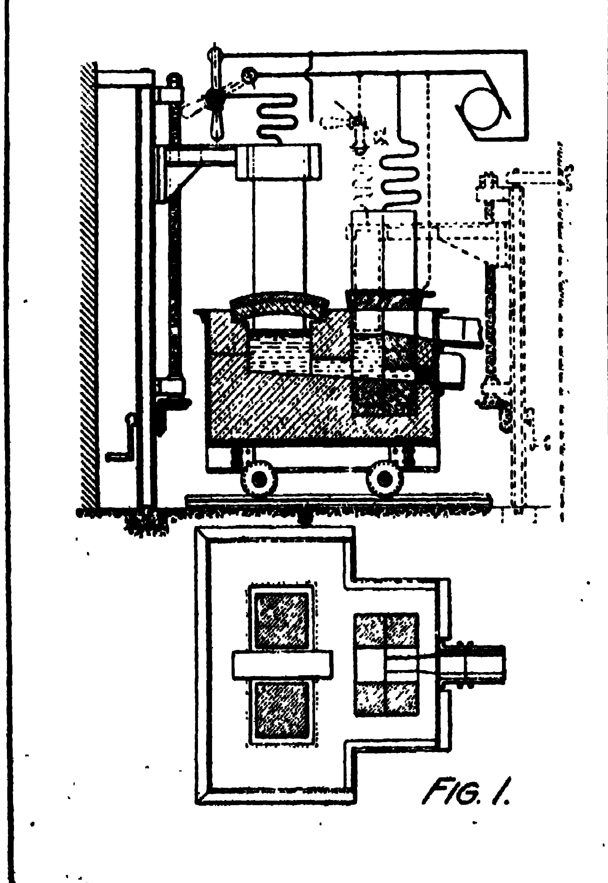
Direct arc steel furnaces are past the experimental stage. They are standard. Hence, they are greatly lacking neither in thermal efficiency nor in reliability as they fall short in these points and succeed on steel. However, they are limited, and sharply limited, as to the nonferrous alloys they can handle.

Iron and the other elements in steel are nonvolatile, or only slightly volatile, at temperatures well above the pouring temperature of steel. Zinc and lead are volatile at comparatively low temperatures. Zinc boils at 920 degrees Cent., lead at somewhere between 1500 and 1600 degrees Cent. Either of these elements will boil out of brasses and bronzes at somewhat higher temperatures, but at temperatures not far above the pouring temperatures of alloys high in zinc or lead.*

All these direct arc furnaces have one or more arcs playing between one or more carbon or graphite electrodes and the charge itself. The charge may be covered by slag, but the arc has a tendency to blow this aside and to play between the electrode and the metal. The temperature of the arc is about 3500 degrees Cent. The arc probably is the hottest source of heat on earth, and is surpassed only by the sun or other still hotter members of the solar system.

As an arc plays upon molten metal, there is a race between the heat coming in from the arc and that passing out through the metal, away from the vicinity of the arc. If the rate

*Compare Johnston, J., The Volatility of the Constituents of Brass, Jour. Amer. Inst. Metals, Vol. 12, 1918, p. 15.
Gillett, H. W., Brass Furnace Practice in the U. S., Bull. 73, U. S. Bur. Mines, 1916, p. 125.
Collins, E. F., Electric Furnace for Melting Non-Ferrous Metals, Foundry, Vol 47, 1919, p. 830.
Hill, C. W., and Luckey, J. P., The Spectroscopic Determination of Small Amounts of Lead in Copper, Trans. Am. Electrochem. Soc., Vol. 32, 1917, p. 335; Met. and Chem Eng., Vol 17, 1917, p. 659.



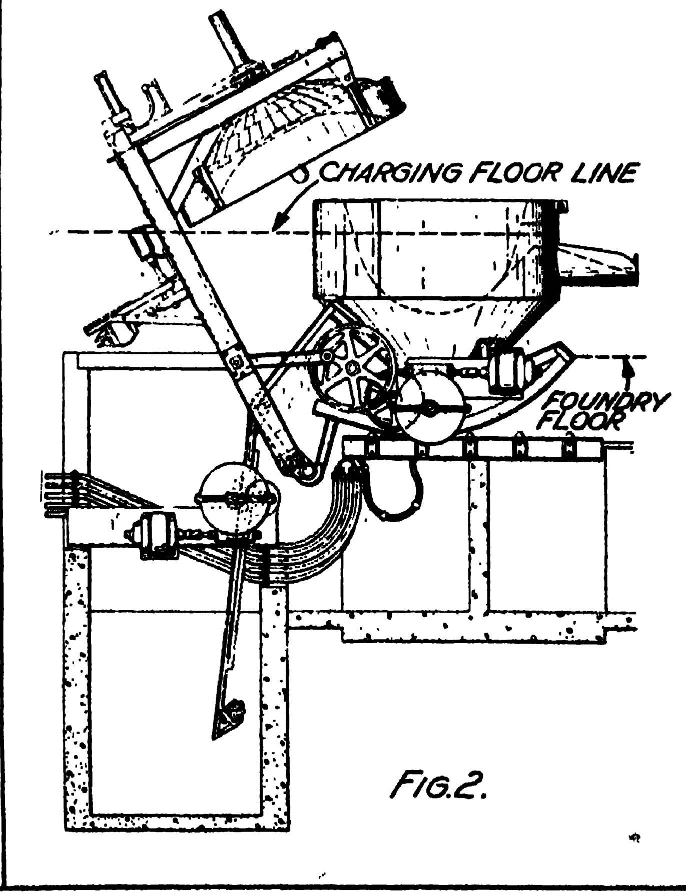


FIG. 1—DRAWINGS ILLUSTRATING THE PRINCIPLES OF OPERATION OF THE DENOLLY FURNACE FIG. 2—SIDE ELEVATION OF THE SINGLE-PHASE SNYDER FURNACE

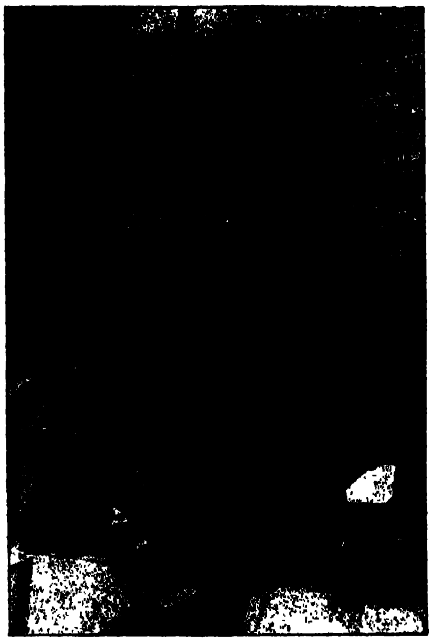


FIG 3—SMALL TWO-PHASE SNYDER FURNACE

of energy input is higher than the rate of heat conduction through the metal, the temperature of the metal under the arc continues to rise. If the heat can be poured before the metal under the arc reaches to the boiling point of its most volatile constituent, there will not be much loss of volatilized metal. The boiling points of iron and the other elements in steel are high enough so that there is no trouble. However, one can no more play a direct arc on a bronze high in lead and not volatilize some lead, nor on a brass high in zinc and not lose zinc, than he can drop a red-hot ingot of metal in water and not get steam.

A true bronze is somewhat different for the boiling points of both copper and tin are high. Brass, nickel-silver, manganese bronze and other alloys containing more than negligible amounts of zinc, are not compatible with a direct arc. Occasionally, some maker of a direct arc steel furnace, who hasn't tried it, and who isn't used to brass, will include brass-melting among the qualifications of his furnace, but after he tries it he becomes more exact in his phraseology and refers to bronze-melting instead of brass-melting.

Back in 1890 Slawianoff* described a scheme for arc-welding blowholes in castings. He states "Experiments show that brass, after electrical casting, becomes materially altered chemically in consequence of burning out the zinc."

While it was plain that zinc losses in a direct arc furnace must be enormous, to get some figures on the loss, the bureau of mines built a small 50-pound direct arc furnace in 1915, setting it up outdoors so as to be able to avoid zinc fumes. In melting ingot of 80 per cent copper, 2.5 per cent tin, 2.5 per cent lead, 15 per cent zinc, the net metal loss was 4.5 per cent. On ingots of 67 per cent copper, 33 per cent zinc, the loss was 7.5 per cent. The arc was only 50 volts, and the furnace was operated with every care to hold down the losses. The alloys both were poured at lower temperatures than normally would be called for commercially.

During a test of a 600-pound Snyder furnace at the Chicago Bearing Metal Co. in 1916, a few heats of yellow brass ingot (27.5 per cent zinc) were made at the request of the bureau of mines. Although the pouring temperatures were low, the metal loss, by weight, was 4.5 per cent, and the average zinc content of the product was under 24 per cent. Moreover, the furnace did not act well, the metal vapor in the arc making it snappy and pulling the power factor down.

FIG. 4 BOOTH ELECTRIC FURNACE USED FOR STEEL MELTING

There has been no commercial use of direct arc furnaces on yellow brass in this country. The only known commercial use of such a furnace was in France during the war. On account of lack of fuel, yellow brass had to be melted electrically, since hydroelectric power was available. So a deNolly-Grammont furnace* that had been used in premelting ferromanganese before adding it to steel, was utilized. This furnace operated at a low voltage. It had huge carbon electrodes, 20 inches square, as it had been found best to use a low voltage arc and distribute it over as much surface as possible in order to reduce the loss of manganese. Manganese is the most volatile of the elements in steel, although its volatility nowhere approaches that of zinc in brass.

The deNolly furnace used, according to photographs shown the writer by Capt. M. Altmeyer, of the French technical commission, was built almost exactly like the sketch shown in the deNolly patent, Fig. 1.

This furnace, operating 24 hours a day, melted about four heats of 2¼ tons each of 60-40 brass per day; one heat in six hours. The average power input was only 175 kilowatts. This rate of power input, low for a furnace of so large capacity, allowed the heat to flow away from the metal below the arc, to a certain degree, and the furnace and its operation were probably as well adapted to handling yellow brass for low metal loss as any direct arc furnace could be, though the lower power input involved thermal inefficiency.

The power consumption was 450 kilowatts per net ton, which is more than twice the energy that is required per ton under similar conditions at least by two other types of electric furnaces.

The gross metal loss was over 6 per cent. No accurate data is at hand on the net loss, but since 3.5 per cent extra zinc (on the total weight charged) was added to the scrap brass melted to keep it up to composition, it could not have been below that figure. In the French military emergency, the inefficiency of this direct arc furnace and its high metal loss of course had to be

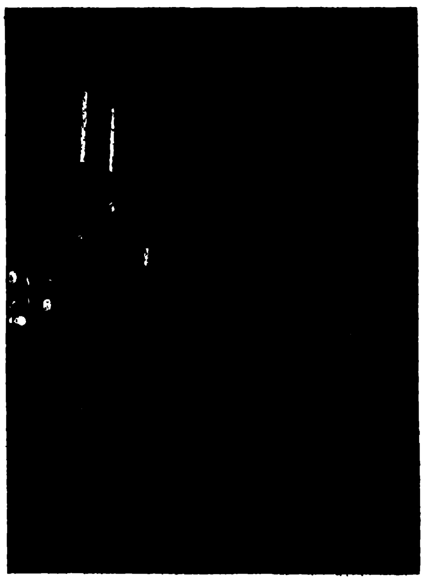


FIG. 5—STEEL MELTING FURNACE MANUFACTURED BY THE PITTSBURGH FURNACE CO.

(*) Slawianoff, N., English Patent, 16,279 of 1890. U. S. Patent, 557,320 of 1907.

(*) See deNolly, H., U. S. Patent, 1,216,961. Grammont, E., French Patent, 487,005 of July 17, 1918.

borne because of the lack of fuel. but under normal American conditions, it would not compete with fuel-fired furnaces, to say nothing of other electric furnaces.

Therefore, we must accept the limitation of the operation of direct arc furnaces to alloys low in zinc. There is not much experimental evidence as to just how low the zinc must be, but it seems probable that 5 per cent zinc would certainly be the upper limit and the limit may be lower. That is, ordinary red brass is probably better handled in other types of furnaces. The situation may be summarized by stating that the direct arc furnace is not at all useful on brass, but may be useful on bronze or other nonvolatile alloys.

Nonferrous alloys more closely allied to steel may be handled in the direct arc furnace. Nickel-chromium, cobalt-chromium, and Monel metal all are handled in this type. Heroult, Greaves-Etchells and Snyder furnaces are in use at the plants of the main producers of such alloys. The Driver-Harris Co. (a), the Hoskins Mfg. Co., Hiram Walker Metal Products Co, the Monel Metal Products Co., the Haynes Stellite Co., the Chrobaltic Tool Co., all use direct arc furnaces (b). Some of the furnaces are as large as 3 tons capacity, others as small as 200 pounds or less.

(a) See Easton, W. H Electric furnace for melting alloys -El. World Vol. 72, 1918. p 295.

(b) See Etchells, H. Discussion. Met End (London). Vol. 14, 1919, p. 113.

All these users seem to be satisfied, and the Monel Metal Products Co. states that the quality of metal produced is better than that from an oil-fired reverberatory furnace.

It is not certain whether or not a direct arc furnace would be suitable for pure copper. Hansen (**) made a trial heat of 2½ tons of copper in a direct arc furnace, copper fumes were given off and the workmen were

FIG 7 LUDLUM FURNACE SIMILAR TO THE HEROULT, BUT DIFFERING IN ELECTRODE OPERATION

made seriously ill. Similar experience has been reported in making titanium copper in a direct arc furnace. Lyon & Keeney (***) state that the volatilization of copper could be prevented by the use of a slag,

(**) Hansen, C. A., Copper Poisoning, Met and Chem., Eng. Vol. 9, 1911, p. 67.

FIG 8—GREAVES-ETCHELLS TYPE ELECTRIC STEEL FURNACE

but as Hansen used a slag in this test, this requires proof. The trouble is not so much in the value of the lost copper, as the loss would be but a fraction of a per cent, but in the poisonous nature of the copper vapor given off.

On the other hand, the trouble may lie in heating the copper unnecessarily hot. Monel metal melts at about 1360 degrees Cent., so that its pouring temperature is well above that of copper. While Monel metal contains 28 per cent copper, no copper poisoning has been noted when melting 1000-pound heats in a direct arc furnace, nor has copper poisoning been reported by any one melting bronze in a direct arc furnace.

The problem is of interest, for if electric melting of cathode copper—which is attractive because it should be possible to obtain a product of high conductivity with considerable ease—is to compete with reverberatory melting in furnaces of 200 to 250 tons capacity, it will have to be carried out in a large, sturdy, thermally efficient furnace. Since 30-ton Heroult furnaces are in operation for refining molten charges of steel and no type other than the direct arc furnace has either been built so large or seems so fitted for use in such large capacities, a direct arc furnace is the logical type for cathode copper, if any type of electric furnace can compete.

Coming now to the use of direct arc furnaces on bronze, there is as yet not much data available except on one alloy.

A Greaves-Etchell furnace recently has been sold to the Japanese mint for use on coinage bronze, and a

(***) Lyon, D. A., and Keeney, R. M., Melting Cathode Copper in the Electric Furnace, Bull. Am. Inst. Min. Eng., No. 92, August, 1914, p. 1741.
See also Smelting Copper Ores in the Electric Furnace, Bull. 81, U. S. Bur. Mines, 1915.

FIG. 6—LARGER TYPE HEROULT STEEL-MAKING FURNACE

3-phase, direct arc furnace of the Heroult type, 1500 pounds capacity, operating on red brass under a glass slag, was used four or five years ago at the Canadian Brake Shoe Co., Sherbrooke, Quebec. No data is available on its operation save that the metal loss was under 2 per cent.

The largest installation of direct arc furnaces operating on bronze is at the Chicago Bearing Metals Co., Chicago, where two Snyder furnaces, of 1-ton capacity each, are operating on a leaded bearing bronze running 70 to 75 per cent copper, 15 to 20 per cent lead, about 6 per cent tin, with small amounts of iron, antimony, and zinc as impurities. All the new lead is added in the ladle, not in the furnace. Two Rennerfelt indirect arc furnaces also are installed, and open-flame oil furnaces are still used, but what yellow brass is melted by this plant is melted in crucibles.

Before the installation of the four large electric furnaces a test was run, early in 1916, on a 600-pound Snyder furnace. This was a single-phase 100 kilowatt furnace with one electrode arcing to the bath, connection being made from the bath by a bottom electrode.

Running on leaded bearing bronze poured at about 1150 degrees Cent., the 600-pound furnace, on 10-hour operation, gave from five to six heats per day, 3000 to 3600 pounds at 350 to 380 kilowatt hours per ton. The net metal loss, on 44 heats was 2 per cent. The distribution of metal when melting this alloy in the different types of furnace then used, was given as follows:

	Per cent metallics in charge obtained in ladle or crucible ready to pour	Per cent metal in ashes or slag, to be recovered	Per cent net metal loss
Crucible lift-out, oil....	95	2½	2½
Crucible tilting-forced-draft, coke	85	12½*	2½
Open flame oil.........	90	1½	5½**
600 lb. direct arc electric	97.9	0.1	2

The 600-pound electric furnace could be plugged up tight and operated entirely closed, without difficulty. There was no trouble from smoke or fumes from it.

It was calculated that 1-ton furnaces would make distinct metal, labor, and crucible savings, and two such furnaces were installed later in the year, the 600-pound furnace being dismantled. These furnaces were the single-phase, 400 kilowatt, top-charging type shown in Fig. 2 and had 700 kilowatt ampere transformers, since the furnaces were designed for hand operation, and a power factor of only 70 was sought, in order to give a stable arc that would hold without constant attention.

Pressure Developed

It soon was found that these larger, higher-powered furnaces could not be operated tightly closed on the high lead alloy. If the door and the upper electrode were sealed up tightly, one of two things would happen, either the luting would blow out, or, if that held, the roof bricks would be loosened by the pressure developed in the furnace. Hence the spout had to be left partly open and the electrode

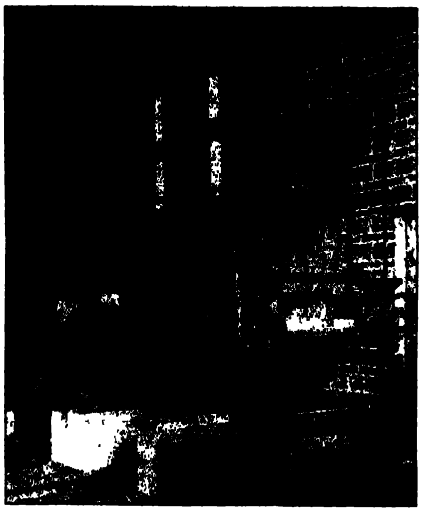


FIG. 9 GREENE ELECTRIC DIRECT ARC FURNACE

allowed some clearance. This let lead and antimony fumes in abundance escape from the furnace, and since lead fumes are poisonous, it was necessary to install an even more elaborate ventilating system than had been required on the fuel-fired furnaces to carry off the fumes.

Electric furnaces do not radiate excessive heat and thus cause discomfort as do the fuel-fired furnaces, but, on the score of fumes, they cannot be said to be any improvement over other furnaces.

One other difficulty was met. The old-type Snyder furnaces were designed for a 70 per cent power factor, but when operated on an alloy that gives up a great deal of metal vapor to the arc, they show a distinctly lower power factor. These furnaces take about 200 volts open circuit, which, under load, falls to 160 or even to 100, depending on the distance the electrode is drawn away from the charge, i.e., on the length of the arc. If the arc is kept long, the power factor is nearly 70, but the arc is snappy. The use of a fluid slag or of a layer of coke or graphite on the metal so thick that the arc does not play on the metal itself also helps to raise the power factor, but are nuisances to maintain. It is probable that a more modern type of direct arc furnace, operating at a lower maximum arc voltage and designed to give about 90 per cent power factor on steel, would operate, even in metallic vapor, at better than 70 per cent.

However, furnaces as installed, gave an average power factor of only 55 per cent, although many attempts have been made to improve it. Most power contracts involve a penalty if the power factor is below 70 per cent, the penalty usually taking the form of an increase in the demand charge.

Neither the furnace operator nor the central station now-a-days wants the power factor of an arc furnace to be much above 90 per cent, and both are pretty well satisfied with one of 80 per cent. Too high a power factor means greater surges on the line and more difficulty in regulation. Nor does a low power factor (if above the penalty figure) mean that the power used costs any more. It does mean that the power house has to have larger generators and larger transmission lines and that the transformer, leads and electrodes have to be larger to carry the extra current, inasmuch as a low power factor, due to the wave of current lagging behind the wave of voltage because of reactance in the circuit, involves carrying current that does not work, around the circuit, i.e., "wattless" or useless current.

A power factor of 55 means that a 700 kilowatt ampere transformer is fully loaded when it is producing 400 kilowatts, while at one of 70 it would give 500 kilowatts. It also means that the demand charge (say $1 per kilowatt per month) is increased in the ratio of 70 to 55. In other words, it costs something like $2000 a year more for power for these two furnaces, at a power factor of 55 than it would if they had a power factor of 70 or better.

The presence of the Rennerfelt furnaces, with their power factor above 70, helps to bring up the power factor of the plant load and so reduces the penalty that would have to be paid if only the old-type Snyders were operated.

That the 1-ton furnaces cannot be operated on the leaded bearing metal while tightly closed, raises the metal

*This figure seems excessive, but was ascribed to dropping of the charge outside the crucible in charging, the extreme heat over the furnace making careful charging difficult.

**This figure includes 3 per cent extra lead that had to be added in the ladle to give the product the same analysis as that from the same charge in crucible furnaces

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loss over that shown by the smaller furnace that was operated tight. Various tests have shown around 4 per cent net loss on the large unit. Inventory figures indicate that these tests may have shown a loss slightly higher than the average loss in regular operation. It is evident that while the direct arc furnaces, operated without being tightly closed, give a lower metal loss than the open-flame oil furnace, they give a higher net loss than crucible furnaces. However, savings due to elimination of crucibles and to lowering of labor costs, due to melting in larger units than crucibles, more than balance this higher metal loss.

It has been most interesting to watch the gradual improvement in operation of the furnaces as the plant gained experience with them and appreciated the value of saving time in charging and pouring. The plant has its work arranged so that molds always are ready for the metal. Large ladles are used for pouring, and charging and pouring are speeded.

One particular means by which this end was attained was by paying the furnace tenders for a full day's work, that is for 10 hours, but allowing them to leave as soon as the standard number or nine heats were made, no matter how quickly they were able to get the heats out. This kept the operators eager to avoid delays, and resulted in better operation and lower power consumption per ton.

This plant aims primarily for large production, and the production per furnace per hour from the Snyders is probably not surpassed by any user of electric furnaces for bronze. Two points about the Snyder furnace make this large production possible. First, the roof is rapidly lifted off bodily for charging so that the charge can be dumped in quickly. Second, the 1-ton furnace has 400 kilowatts behind it, which means a higher thermal efficiency, and hence more rapid production than it would if it had only 300 kilowatts.

Spare Roofs Kept

The high power input, means a rather short life for the refractories. This has been accepted, the roof being made of firebrick and lasting 90 to 140 heats. Spare roofs are kept ready to put on. The hearths, rammed of two parts carborundum fire sand to one part fireclay, bonded with molasses, last about 200 heats. The consumption of 4-inch graphite electrodes runs from 3 to 4 pounds per ton. The furnace over long periods of time, gave the following results per furnace in output and power consumption:

1917 continuous 24-hour operation—hand control—20 tons in 24 hours at 290 kilowatt-hours per ton.

1918 2-shift, 19-hour operation —hand control—13 tons in 19 hours at 280 kilowatt-hours per ton.

1919 1-shift, 9-hour operation—automatic control, 9 tons in 9 hours at 300 kilowatt-hours per ton.

Had no improvement in operation been made, the power consumption per ton would have risen in 1918, as the cooling during the idle period between shifts handicaps the furnace when comparing with continuous operation. The output fell about as would be expected with the change from 24-hour to 19-hour operation, but that the power consumption, per ton, did not rise to 300 or over at the same time, but fell instead, is due to improvement in rapidity of charging and pouring.

Development Due to Efficiency

The output of 1 ton per hour on 9-hour operation in 1919 is phenomenal when we consider that this is a better output per hour than was obtained in 1917 on 24-hour operation. The power consumption of only 300 kilowatt-hour per ton on 9-hour operation compared with the earlier figure of 290 per ton on 24-hour operation also is good. These 1919 figures are partly due to the advantages of automatic electrode control. They are rather better than the Chicago Bearing Metal Co. plans to get in future 9-hour operation, because, with the low power factor of the old Snyder furnaces, it is necessary, in order to get these figures, to overload the transformers so that they heat up unduly. However, they represent what could be done on metal poured at about 1150 degrees Cent. in a 1-ton direct arc, 400 kilowatts furnace that has a transformer that will stand an output of 500 kilowatts for short periods.

A 1-ton single-phase Snyder furnace, like those used at the Chicago Bearing Metals Co., complete with all transformers, meters, etc., but with hand instead of automatic control, was priced by its makers, the Industrial Electric Furnace Co., Chicago, in January, 1920, at $16,000. With automatic electrode control the price was $17,000, and the more modern 1-ton, 2-phase (from 3-phase by Scott connection) furnace, shown in Fig. 3 with automatic electrode control, also at $17,000.

There are many other direct arc furnaces on the market, such as the Heroult, Greaves-Etchells, Ludlum, vom Baur, Price-Dixon, Pittsburgh, Booth, Greene, etc., which are used on steel, that would be expected to give results similar to those given by the Snyder on bronze. They all vary a trifle in shape, in the number of electrodes used and the way they are connected to the transformers, but their differences are in minor structural details rather than in principle. A few of these steel furnaces are shown in Figs. 3 to 9.

As a class, direct arc furnaces are the type most approved by commercial usage for melting steel. They are in fairly wide and successful use among the firms melting nonferrous alloys high in nickel. They can be used on true bronze, but on alloys of appreciable zinc content or those of high lead content, their use is either impossible or attended by excessive metal losses.

This type has been so highly developed by use on steel that, outside of the problem of refractory life, their reliability is high. They have good thermal efficiency, are readily built in large sizes, and, save in single-phase furnaces, the load on all three phases of the power line can be fairly well balanced.

As few firms melt true bronze alone, and most firms need a furnace that will handle alloys of at least 10 per cent zinc content, even if no yellow brass is to be melted, the direct arc furnace covers but a small part of the nonferrous alloy field. It is useful in its own limited field, but it lacks versatility. To solve the problem of melting alloys high in zinc, some electric furnace of the hearth type must be sought which will avoid the local superheating that occurs immediately under the arcs of the direct arc type. This brings the consideration of the indirect arc type, which will be discussed in the next which will be discussed in detail in the next article of this series.

The Electric Furnace Co., Alliance, O., maker of Bailey electric furnaces for melting nonferrous metals, has opened a middle western office at 301 Frisco building, St. Louis, in charge of W. E. Prosser.

The authorities in charge of the Charleston navy yard, Charleston, Mass., are contemplating the erection of a brass die foundry plant and would like to get in touch with manufacturers of equipment for this purpose.

How and Why in Brass Founding

By Charles Vickers

Melting Alloys of Copper in a Cupola

We have some copper castings to make that are very heavy. One, in the form of a pipe with brackets weighs approximately 5200 pounds. As our brass furnaces are only 1000 pounds capacity, it will be necessary to melt the copper for these castings in one of our cupolas. We intend to cast a 6-inch cleaner ring on the top of the flange, and also to use heavy risers. Any information on melting copper in a cupola will be greatly appreciated.

The great objection to melting copper and copper alloys in a cupola is the fact that the metal comes into contact with the fuel which ordinarily contains an element which is harmful to these metals. This harmful element is sulphur. If this was absent copper could be handled from a cupola just as well as cast iron. When fuel containing sulphur is burned, the sulphur is converted to sulphur dioxide, which is greedily absorbed by the copper unless it is protected from contact therewith. Copper has a great affinity for sulphur, also for oxides of sulphur. Copper absorbs and retains sulphur dioxide which being a gas aerates the castings made from such contaminated metal. The effect is shown in spongy castings. Because of this fact, it is impossible to get castings that are sound from copper melted in contact with the fuel, unless the melting occurs so rapidly in the cupola, that the copper is *down* before it has absorbed more sulphur than it is possible to eliminate by the usual methods of deoxidizing copper for making castings.

Copper containing oxygen is not spongy as the oxygen exists as copper oxide which is a solid. It is the reaction between this oxide and sulphur, or the absorption of sulphur dioxide formed in the furnace atmosphere that causes copper to make spongy castings. A thorough understanding of these facts will suggest methods of handling copper in the cupola.

A low sulphur fuel must be used in melting; charcoal would be best no doubt. This suggests that an admixture of charcoal with the coke is advisable. The copper should be melted as quickly as is possible, taking care to avoid an excess of air which gives a strongly oxidizing atmosphere. This means a moderate blast, better to starve the fuel of air, than to give it too much, as the excess would be absorbed by the copper. As it is difficult to reconcile this latter requirement with fast melting, a compromise is best; get it down a little slower, but when it is down, run it out of the cupola into the ladle on to the top of a layer of ignited charcoal which will float and protect the metal from the atmosphere. In pouring, hold back the charcoal, and do not skim the metal clean.

Use a little more deoxidizer than what is usually added, and have it warmed and in the bottom of the ladle, so the copper is tapped upon it. It is essential that the casting be provided with liberal risers; the risers being large in circumference and built up higher than the sprue, or pouring basin. Have hot copper in reserve, and immediately after the sprue has set, fill the risers gently, dribbling the metal into the risers. For a heavy casting pumping with a copper rod may be necessary to obtain a sound casting.

Aluminum Alloy for Pistons

Please give us a formula for an aluminum alloy suitable for pistons for automobile engines.

The following alloy will be found satisfactory: Aluminum, 88.50 per cent; copper, 11.50 per cent. To produce the alloy, first make a hardening alloy of 50 per cent copper and 50 per cent aluminum. Melt 22.50 per cent of this alloy with 77.50 per cent ingot aluminum.

Brazing Methods

We have experienced some difficulty in getting a suitable formula for a brazing solder. We desire the formula of a metal that will melt easily when the torch is applied and which will not blow away. We have tried an alloy of half zinc and half copper, and also one composed 52 parts copper, 47 parts zinc, and 1 part tin, for brazing thin copper tubing into yellow brass castings. Neither of these alloys gave a successful joint.

It appears probable the difficulty is due more to the method of brazing than to the composition of the alloy forming the solder. Both the solders tried give good results. The blowing away may be due to the swelling of the borax in which case it may be advisable to use instead a mixture of soda ash and boric acid finely powdered and well stirred together.

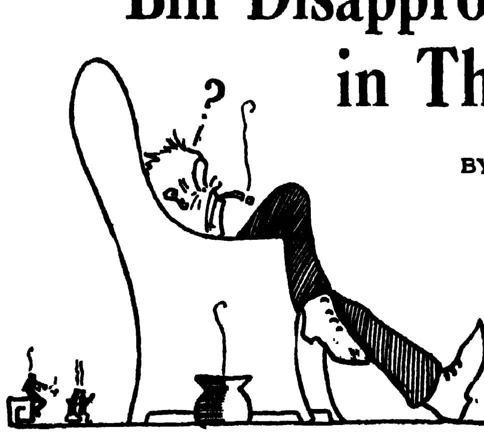
The following is a very fusible solder: Copper, 44 per cent; zinc, 50 per cent; tin, 4 per cent, and lead, 2 per cent.

Antimony Hardens Electrotype Metals

We would like to obtain the formula for electrotype metal, as we desire to make new metal to mix with the scrap we use. The alloy breaks when we try to bend it, and it is our belief that it is burnt and requires new metal to give it life. We shall be pleased to receive your suggestions.

The cause of the metal breaking is not oxidation or burning. If the alloy is oxidized it will be too thick to pour, that is it will run sluggish. The brittleness is due to excess antimony which is derived from some of the other alloys used for type. There are approximately five different alloys used for type; namely, type metal, electrotype metal, linotype metal, monotype metal and stereotype metal. Electrotype is the softest alloy, a good mixture being as follows: Lead, 93 per cent; antimony, 4 per cent, and tin, 3 per cent. Type metal is the hardest consisting of lead, 58 per cent; antimony, 26 per cent; tin, 15 per cent, and copper, 1 per cent. This alloy will bend only slightly, while electrotype will bend until the two ends nearly come together. If the hard metal is added to the electrotype it is obvious the latter will be hardened by the antimony to the point where it will break readily. Linotype is also too hard for electrotype metal, a standard mixture being lead, 83 per cent; antimony, 12 per cent, and tin, 5 per cent. Stereotype is very similiar to linotype, and monotype is harder. If these alloys are mixed indiscriminately and melted, the resulting mixture will be too hard for electrotype. An analysis should be made and then lead can be added to bring the composition to that of electrotype as has been given here.

Bill Disapproves Military Tactics in The Foundry



BY PAT DWYER

ONE night recently after we had disposed of the frugal evening meal, I felt called upon to exercise the authority duly vested in me as deputy head of the family. 'Tis a delicate duty and one that I avoid as much as possible, leaving the enforcement of law and order in the hands of a charming, and competent person whom I promised to love, honor and cherish and so forth a good many years ago. I have no distinct recollection of just what I *did* promise on that eventful occasion and I may have committed myself to a bigger contract than I realized.

There is a tacit understanding that my authority ceases at the front door. I am allowed, in fact I am encouraged, to navigate the ship on the broad ocean of industrial life in any way I please, as long as I bring home a reasonably full cargo on the first and the fifteenth of each month; but when I get the range lights in line and make the front door, the pilot comes aboard and takes command. It is a satisfactory arrangement and gives me a chance to rest before taking the bridge again in the cold grey dawn and put in the day trying to claw my way off the lee shore of the H. C. L. and beat into the open sea.

On this particular occasion I settled myself comfortably in a big chair by the fire and was enjoying a quiet draft of the old weed when I was approached by three beautiful young ladies. Candor compels me to admit that they were in anything but a ladylike frame of mind, and, furthermore, they all insisted on talking at once. I finally gathered that the argument hinged upon the proper division of labor in washing the dishes. No one wanted to wash them, it also appeared from the evidence in the case that no one wanted to dry them, but each one was ready and willing to put them away on the shelves. I advised them that their mother was the proper person to settle the disputed point but I found that she was upstairs at the time. You will agree with me that it was a situation requiring tact and diplomacy. Strong arm stuff—to employ a colloquial expression—might have filled the bill, but these young ladies had always regarded me as their favorite relative on the father's side and I simply could not see my way clear to tapping them on the head with a poker or a section of gas pipe or whatever it is these strong arm lads employ as their favorite weapon.

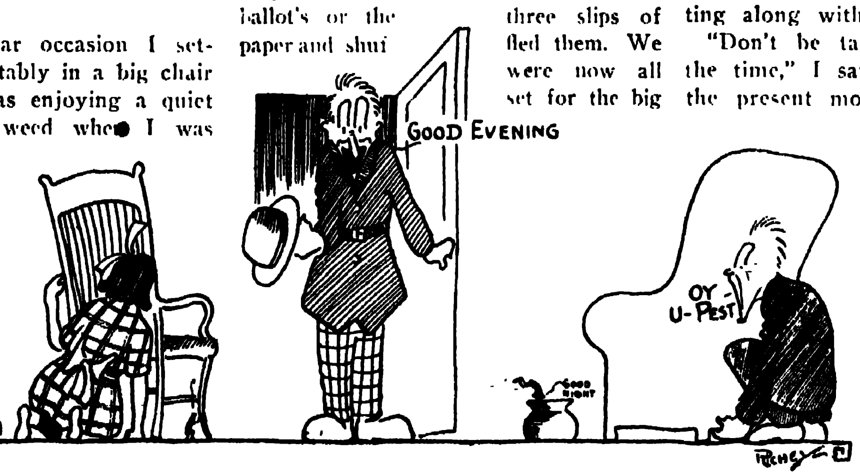
I instructed the youngest of the three to bring me a pair of scissors, a pencil and a strip of nice white paper. The paper was cut into three equal parts and then I wrote on one piece, "You will wash the dishes"; on another, "You will dry the dishes" and on the third, "You, dear heart, will put them away" The oldest of the three brought me my one and only hat into which I dropped the ballot's or the three slips of paper and shuffled them. We were now all set for the big act. I instructed each one to close her eyes and draw a slip out of the hat. Each did so and having read the words on the respective slips stood at "attention." I gave the word "About face, forward march" They pivoted on their toes and departed for the kitchen solemnly chanting the old refrain: "Hay-foot, straw-foot." When they reached the kitchen, believe me, the dishes flew through their hands with military speed and precision. Later, when their lady mother appeared on the scene they all insisted on telling her at once of the magnificent method I had inaugurated for getting the dishes washed, but she was not impressed.

"H'm," said she (she uses that expression sometimes), "I could have washed the dishes a dozen times over while you were going through that foolish rigmarole."

I was seriously contemplating starting a discussion on the merits of compulsory military training, not that I expected to score a point, for many years association has taught me that I would gain nothing except perhaps a little excitement, when the door opened and Bill stood framed in the doorway.

"Good evening, ladies and gentlemen," said he. "How are you getting along with the work?"

"Don't be talking about work all the time," I said. "We are busy at the present moment enjoying a few moments of well earned repose and will be pleased to share the fredom of the city and all that kind of thing with you, but lay off that work stuff." With a view of diverting the conversation into pleasant channels and also with the expectation that Bill would be favorably



BILL ENTERS WITHOUT GIVING THE COUNTERSIGN

impressed with the line of tactics I had pursued in disposing of the dish washing problem I outlined briefly the events of the past half hour.

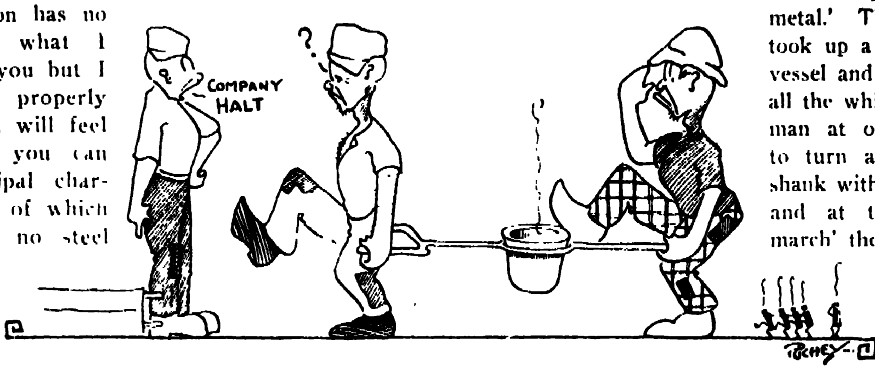
"Good work," quoth he. "This military dope has several commendable features and seems to have filled the bill in a satisfactory manner in the present instance, but that does not say that military methods are the best to apply to all industrial problems. I'll tell you of an incident that came under my observation one time which prejudiced me against the stiff, formal methods engendered by military training.

"Many years ago I had the pleasure of conducting the operations in the foundry department of a tidy little jobbing plant. The president and principal owner of the business was a likable old gentleman who wore glasses, carried a cane and walked with a limp due to having lost part of one heel many years before. Of course this description has no direct bearing on what I started out to tell you but I like to tell a story properly and I am sure you will feel more interested if you can visualize the principal character. At the time of which I speak there was no steel foundry in the vicinity, but there was quite a market for steel castings among the iron and steel plants, coal mines, railroads, shipping and other industries. The old gentleman conceived the idea of installing a small bessemer converter to handle some of this business. He proceeded to get in communication with the makers of this line of equipment and with commendable caution requested to be given the opportunity of visiting some plant where a converter was in operation.

"The manufacturers wrote him to the effect that if he came to a certain city they would be delighted to extend him this privelege and afford him every opportunity to examine one of their vessels which had been recently installed in a navy yard. As I said before, or maybe I forgot, anyway I intended to say that we were on right friendly terms, so that when he proposed that I should accompany and assist him in giving the proposition the up-and-down and the once-over I did not throw any obstacles in his way. I did not say that the foundry would shut down, or blow up, or go on the rocks during my absence or hand him any of those lines of bunk which form the stock of trade of those lads who are afraid of their jobs or who like to kid themselves into the belief that they are the king pin around which the works revolve. Not at all. I bought myself a new tie, a shave, a shine and a haircut and repaired to the station in the morning at peace with all the world and ready, if necessary to travel to Timbuctoo.

"The manager bought two tickets, each one about as long as a flat-car, and we climbed aboard the train. Eventually, we arrived at our destination and hunted up the office of the converter people. The representative of the company was glad to see us. He said he was and I have no reason to doubt his word. He conducted us personally to the navy yard and secured admission for us to the foundry. It was quite a shop in which they made some exceedingly nice work. The steel unit had only been installed a short time and the crew was still undergoing a course of training, modeled on strict military lines and carried out with mathematical regularity. The commanding officer stood in the middle of the gangway, midway between the cupola and the converter. The furnace tender approached him, saluted, and reported that the furnace was filled to the tuyeres. The officer returned the salute and ordered him back to his post of duty. When he had done so he stood at attention with his tapping bar loosely held in the right hand in a vertical position close to the body. At the command 'Tap the furnace,' the bar was brought smartly to the horizontal position, the weight of the forward end being supported by the left hand, the left foot was advanced one pace, the point of the bar brought into contact with the furnace breast and thrust forward as in bayonet exercise, 13, chart 1. The furnaceman withdrew his bar and stood at attention until the ladle was filled, then at the necessary words of command, he seized his bot stick and plugged the runner. Another bird, probably the bo's'n, blew one blast on a whistle which was suspended by a cord around his neck and the craneman hoisted the ladle. At two blasts he ceased hoisting and traveled in the direction of the converter vessel. With three blasts he pulled up on the auxiliary hoist and tipped the contents of the ladle into the vessel and at four blasts he returned the ladle to the pit in front of the cupola spout.

"While the heat was blowing, the pouring gang was lined up in front of the vessel, two men to each shank. They all stood at attention, eyes front, toes out, heels together, with the ladle shanks held horizontally and spaced at equal intervals and at a minimum elevation of 30 inches above the floor. When the metal was ready, the orders were rapidly given: 'Cease blowing; tip the vessel; No. 1 pair advance three paces and receive metal.' The first pair of men took up a position close to the vessel and had their ladle filled, all the while marking time. The man at one end was ordered to turn around and catch the shank with his back to the ladle and at the words, 'Forward march' they stepped out briskly in the wake of a man detailed for that purpose, who led them to the molds which they were to pour. Having reached their destination the lad in front yelled, 'Halt, lower ladle, No. 2, about face. No. 1, as you were. Attention company, take ladle, lift ladle. One pace forward, march. Ready, present, pour, UP.' They were conducted in turn to several small molds and the performance repeated at each until the ladle was emptied. The retreat was then sounded and they went through a series of evolutions which eventually carried them back to the converter.



CARRYING IRON DOESN'T INTERFERE WITH THE GOOSE STEP

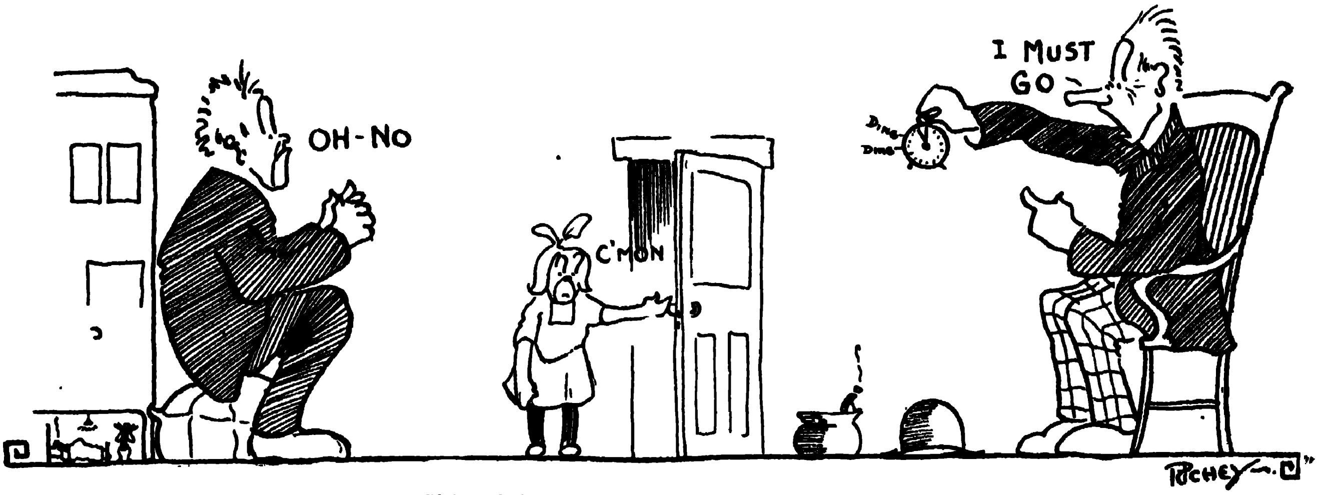
"Each pair of men was advanced in turn and put through the same course of sprouts. The scheme worked well except in a few instances. If any of the men took a step more or less than that prescribed in the regulations, he was ordered to halt. The ladle team had to lower the ladle to the ground and repeat aloud the 14 points in the sequence of operations necessary to pour a ladle of steel. Having done this satisfactorily they were ordered to pick up the ladle, retrace their steps to where the glaring fault had been committed and carry on from that point. By the time these lads reached the mold the

metal was set solid in their ladle.

"I don't know under what heading these frozen ladles were entered on the foundry daily report form, but it is quite probable that they were reported as casualities. The old gentleman and I sized the situation up comparing the operating costs with what they would be if all the commanding officers, red tape and formality were dispensed with and decided that the process was feasible and would meet our requirements. We returned to the old home town and the firm opened negotiations for the purchase of a parcel of land opposite our existing plant. At that time the lot had a normal value of about $500, but some one had tipped off the owner to the effect that here was a chance to make some easy money so he promptly jumped the price to $5000. The old man refused to consider the price and I bet if what he said about the owner of that piece of land was converted into liquid steel it could have been carried a mile and then used to run needles."

Bill got up and looked at his watch. "Well," said he, "I am glad I dropped in, I should like to stay a while longer and listen to the conversation but I have to be away about the master's business. Good night."

He closed the door and you can imagine my surprise when I heard the lady who is always finding fault with me for bringing home slang from the foundry, say *"Good night,* is right."



BILL'S ALARM CLOCK BREAKS OFF THE DISCUSSION

Metal & Thermit Corp. Makes Changes

The Metal & Thermit Corp., New York, has appointed James G. McCarty manager of its Canadian branch, with headquarters in Toronto, and has transferred Robert L. Browne from its New York office to Boston, where he will have charge of all sales in the New England states. Mr. McCarty was graduated from Stevens Institute of Technology in 1906 and became affiliated with the Metal & Thermit Corp. in 1909. He has represented the company in many sections of the United States and Canada. Mr. Browne has been associated with the New York office since 1917.

Automobile Castings Made in Green Sand

Question: We are interested in the manufacture of automobile engine pistons and would like to know how this class of castings is handled in the large foundries which specialize in that kind of work. Are the castings made in dry or green sand?

Answer: Each of the prominent foundries engaged in making automobile engine castings has developed special appliances, features and methods for producing them economically in huge quantities. Dry sand molds and cores are used exclusively in some shops for some of the parts, while others depend altogether on green sand and others again use a combination of dry and green sand.

In some places the practice is to cast the pistons open end up. while in others the open end is cast down. In a typical and highly successful method used by one of the most prominent foundries engaged in this line of work, the castings are made entirely in green sand and cast with the open end down. They are molded four in a flask and poured from a common strainer gate in the center. The copes are made on one machine and the drags are made on another; one man attends each machine and the daily output of each pair is 90 molds or 360 pistons.

The machine for making the combined drag and cores is the rollover pattern-draw type and the cope machine is a plain stripping plate. The patterns on the drag machine are machined out considerably larger than the diameter of the required cores. A sleeve or lining, split longitudinally, with each half carrying the boss for the connecting rod, is dropped into each of them. The sleeves are machined accurately, the outside diameter is finished to a loose sliding fit and the inside conforms to the exact size of the required cores.

The sequence of making the drag mold is as follows: The pattern is cleaned with a jet from an air hose; the loose sleeves are dropped, into place; the drag flask set on and facing sand riddled in. Sand then is shoveled in and the cores tucked with the fingers, especially around the bosses. The drag is then filled with sand and rammed lightly, scraped off, loose sand sprinkled on and a perforated bottom plate rubbed down to a bearing. A frame suspended from a counterweighted cord and provided with four 3/16-inch rods, long enough to reach within 1/4 inch of the top of the patterns, is pulled down and forced through the holes in the bottom plate, one of the vent wires going into each of the cores and providing an adequate means of escape for the steam generated in pouring the castings. When the pressure is released the counterweight automatically lifts the vent rod frame up out of the molders' way. The drag is then clamped and rolled over, vibrated, the clamps removed and the mold stripped.

The loose lining pieces stay on the cores. The mold is lifted to a circular stand and the molder extracts the loose pieces in turn from each of the cores and returns them to their places in the pattern which in the meantime has been rolled back to

its original position. The drag is then lifted off the stand and set on the floor.

The cope is rammed on an adjoining machine. It is not rolled over. The patterns are stripped through the plate and the mold is lifted off and set on the drag. Each flask is poured with a hand-ladle, the iron being supplied by a 1-ton buggy ladle in the gangway.

An iron mixture containing 10 per cent steel and approximating the following analysis is used for these piston castings: Silicon, 1.80 to 2.00 per cent; sulphur, under 0.10 per cent; phosphorus, 0.20 to 0.30 per cent; manganese, 0.50 to 0.60 per cent.

An alternative method whereby the castings are made open end up, one casting to a flask is described in detail in the February, 1915, issue of The Foundry. The molds are made in green sand and the cores are dried.

Making a Crosshead Pattern in a Hurry

BY M. E. DUGGAN

IT OFTEN happens that the broken piece for which a new pattern is required is part of a manufactured machine. When the machine was built the paramount idea in the designer's mind was to produce something having an artistic appearance. Little consideration was given to the material, labor and time that must be spent in making the patterns and molds for the castings.

The drafting room is the proper place to bring up the question of speed, provided that the draftsman understands patternmaking and foundry practice or at least has a general knowledge of the way in which work is done in those departments. In that event he can simplify his designs and lighten the work of the patternmaker and molder. This applies not only to the original casting but also to cases where the casting breaks in service in some distant location where the original pattern is not available and it becomes necessary to make a new one in a hurry.

An instance of this kind was brought to my attention when the sliding crosshead on a large hydraulic draw bench broke. To make the repair a new pattern was required and, furthermore, it was needed in the shortest possible time. In a great many places the shortest time possible means when the pattern is finished, but in a rolling mill it means today.

A drawing of the part which had broken was handed to me and I was asked to name a delivery date for the two castings. I said it would require three days if I had to follow the design shown on the drawing, but if I was allowed to alter the design, an alteration which would in no way affect the usefulness of the casting I could promise delivery in one day.

Two views of the required casting are shown in the illustration, Figs. 1 and 2 There were four cored pockets, which are not shown, for each of which a specially made core box had to be provided. As they were of no particular use they were omitted in the new pattern. The shape of the pocket *A* was changed to that shown at *B* so that it might be molded in green sand, thus eliminating a special corebox and the baking of a dry sand core.

The band saw and sand paper were the only tools used in making this pattern. The journal, Fig. 8, was molded in green sand. A small corebox for the anchor pockets was made easily and quickly. The five cores were fastened to the green sand core with nails.

The complicated design of a machine part is not always the cause of delays in making the pattern or mold. Some patternmakers on account of their lack of knowledge of foundry practice, plan their work in such a way that material, time and labor are wasted. Two examples showing instances of this kind are shown in the illustration, Figs. 3, 4, 5, 6 and 7. These patterns were made in two different pattern shops. They are nearly the same design as the cross head pattern shown in Fig. 1 and 2.

Patterns *A* and *B* shown in Fig. 3, were made with core prints. For pattern *A*, a core shown in Fig. 4 was made and another corebox for the anchor cores, shown in Fig. 6. The body corebox was made with loose

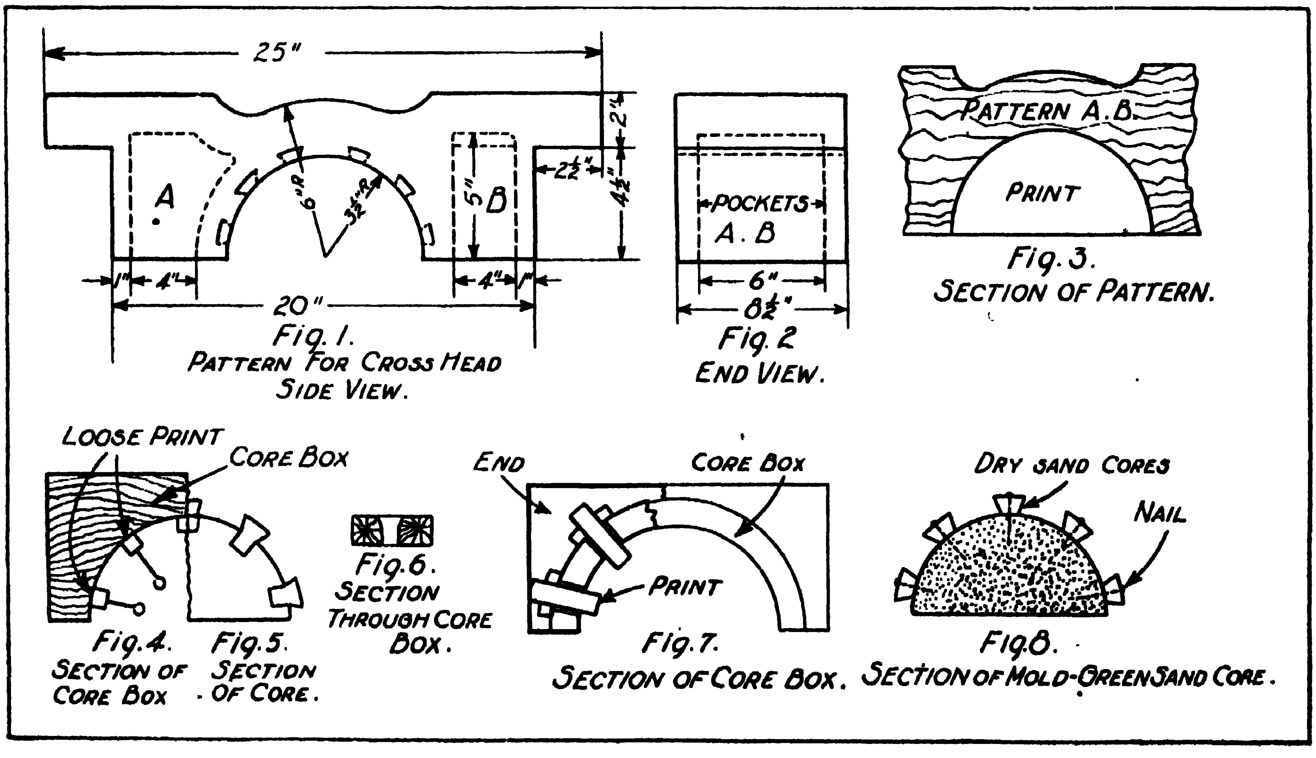


Fig. 1. PATTERN FOR CROSS HEAD SIDE VIEW.

Fig. 2 END VIEW.

Fig. 3. SECTION OF PATTERN.

Fig. 4. SECTION OF CORE BOX

Fig. 5. SECTION OF CORE.

Fig. 6. SECTION THROUGH CORE BOX.

Fig. 7. SECTION OF CORE BOX.

Fig. 8. SECTION OF MOLD-GREEN SAND CORE.

prints on the inside to receive the pocket cores. A section of the assembled core is shown at Fig. 5.

The corebox was made as shown in Fig. 7 for pattern *B*. Instead of making the prints for the anchor pockets loose and securing them with wire pins as in Fig. 4 the prints were passed through holes cut in the body of the corebox. To make the job still more complicated each print was secured in place with two wood screws.

Match Plate for Cistern Pump Base Pattern

Question: We wish to make a match plate to mold the base for a cistern pump. The bottom inside diameter is 7 inches, outside diameter 8 inches; top 6 inches outside and inside diameter. It has a taper of 1 inch to the foot. In using a ⅜-inch match frame I do not have sufficient thickness of wall over the green sand core to run metal. Is there some other way to make this plate?

Answer: From the data at hand we are inclined to the opinion that you have been trying to make one plate on which to make both cope and drag. That is not practicable, for as you have noticed, the walls of the green sand core cut through, or nearly through the sides.

Two pattern plates are necessary for molding castings of this description, one for the cope and one for the drag. To make the cope pattern plate the mold is rammed on the original pattern in the usual way, care being taken to make all partings firm and accurate. The cope is taken off and finished and the pattern is lifted off the drag. A *yankee slick* or a *double ender* is employed to shave a thickness of sand, approximating the metal thickness in the pattern, off those parts of the core which cut through on the sides. The match plate frame is then set on ready for replacing the cope. Another mold is made for the drag pattern.

To assure that the molds made off the new patterns may coincide, the first cope is laid on its back on a board and the pattern set into it carefully. It is then filled with sand, a drag set on, rammed and then both cope and drag are rolled over. The cope is lifted off and set upon the first drag and the mold is ready to be poured.

A cope is rammed upon the second drag which now holds the pattern. After lifting off the second cope a thickness of sand is shaved off those parts where the side walls cut through as in the case of the cope pattern plate. In this case the sand is cut off the cope and in the other case it is cut off the drag. In both cases it will be necessary to cut for about ¼ inch past the print all around in order that the metal may connect.

A match plate frame is placed on the second drag and the cope replaced after which both molds are poured. When the resulting castings are cleaned and ready an experimental mold is rammed on each and the cope tried on the drag. By dusting flour on the parting before closing the mold it will be possible to see how the parts "touch" and if necessary the flask pins may be adjusted a trifle either way to make a fit

C. H. Martin and Gustav Schirmer have been transferred from Harvey, Ill., to the Pittsburgh and Detroit offices, respectively, of the Whiting Foundry Equipment Co.

Column Bases Made in a Small Jobbing Shop

By W. F. Blocher

Recently we received an order for a large number of cast-iron column bases, as shown in the accompanying illustration, varying in size from 3 feet to 4½ feet square and weighing from 1300 to 3500 pounds each.

Through co-operation between the pattern shop and foundry superintendent we adopted what we believe to be the best and most secure method of producing these castings without waste of valuable time and labor in the foundry. Fig. 1 shows one of the bases to be cast. The castings were all made in cores; the pattern was merely a square box, Fig. 2, with the cap plate *A* fitted with dowels. The pattern was given ⅜-inch taper on all sides and the core box was made accordingly; this feature, of course, was a great advantage to the molder in setting the cores. Fig. 3 shows the main core box for the body of the base; these cores were made in four sections, therefore only one quarter box was necessary. The box was arranged to reduce time and labor in the production of cores. Fig. 4 shows the core box for the center cores. The two center cores were set after placing the four large cores in the mold. They were made to touch heavily on the cope, doing away with the necessity of core prints on the cope side of the mold.

The molds for these castings were very simple and easy to make. The drag half of the mold was made and the pattern drawn in each case while the cope half was being rammed.

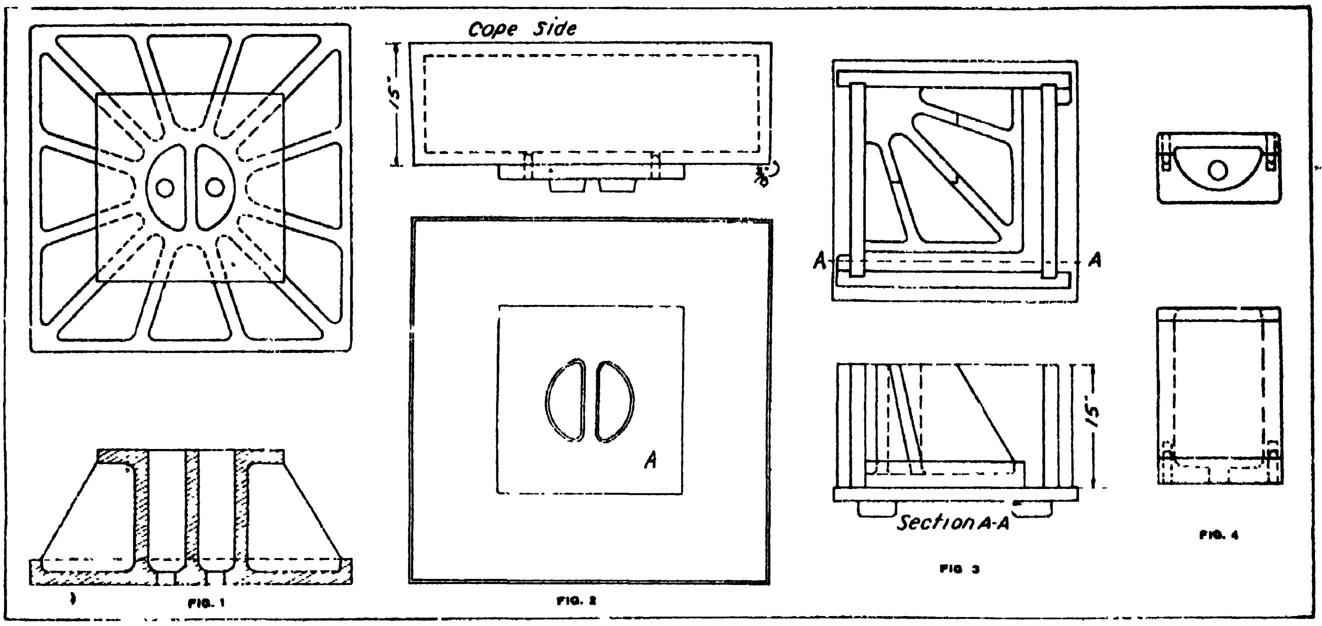


FIG. 1 FIG. 2 FIG. 3 FIG. 4

COLUMN BASE TOGETHER WITH PATTERN AND COREBOXES USED TO MAKE IT

THE FOUNDRY

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Contents

Production Overcomes Handicaps

STEEL and coal strikes, coupled with manufacturing difficulties incident to an unusually severe winter, failed to neutralize the acceleration of production in all grades of foundry iron. The annual statistical report just issued by the American Iron and Steel institute reflects in the last-half totals the unprecedented activity in castings manufacture which originated early last summer and has continued with increasing vigor to the present time. Despite handicaps previously mentioned, the last six months of 1919 showed a slight gain in output of foundry iron and ferrosilicon, and also in malleable grades. The total of foundry iron and ferrosilicon, which are classified together, was 2,436,023 tons for the first half and 2,480,735 for the last, showing a gain of 44,712 tons or 1.84 per cent. Malleable picked up at a higher rate, the first six months showing a total of 465,823 tons, while the last totaled 543,226 tons, making a gain of 77,403 tons or 16.59 per cent.

The past year's totals showed a slight loss in production over 1918 as wartime demand established a tremendous total for that year. Business inertia, which seized all industry immediately after the armistice, exerted a strong influence upon blast furnace activities throughout the first six months of 1919. This effect was swept away by a steady demand for iron and steel products which arose about midyear. Foundry activity took the lead in the recovery, and for a time many furnaces which had been devoted to basic iron were swung over to making foundry grades. Later these, for the most part, reverted to basic.

The total production of pig iron in 1919 was 31,015,364 tons. This constituted a loss of 8,039,280 tons or 20.58 per cent as compared with the 1918 total of 39,054,644 tons. The influence of foundry iron demand is shown by a comparison of production figures for foundry grades in the two years mentioned. In 1918, the total output of foundry iron and ferrosilicon was 5,145,260 tons, while in 1919 it was 4,916,758 tons. The difference is 228,502 tons, which is a loss of only 4.44 per cent on the foundry grades.

Malleable iron also was a factor in maintaining the comparative loss in output at a low figure, although not to so great an extent as were the other foundry grades. The total production of malleable iron in 1918 was 1,117,914 tons, while in 1919 it was 1,009,049, showing a loss of 108,865 tons, or 9.74 per cent. Malleable iron production furnishes an interesting feature of iron history of the past decade. During the past 15 years with but few exceptions, malleable has shown a marked increase each year. The curve representing the total yearly production has had several dips, it is true, but the main tendency has been upward. In fact the acceleration of malleable production has been closely parallel with the growth of the total iron output of the country. During the five years from 1904 to 1908, inclusive, the average annual production of pig iron was 21,302,796 tons. During the past five years, which include of course those years in which American blast furnaces were striving to meet war demands, the total average production was 35,608,446 tons. The increase in yearly average as shown by comparing the two 5-year periods was 14,305,650 tons or about 67 per cent. In malleable, the first 5-year period shows an average yearly production of 586,740 tons, and for the past five years, 978,789 tons, giving an increase of 392,049 tons, or close to 67 per cent. Compared on the same basis, foundry iron and ferrosilicon show only about 14 per cent increase

Trade Outlook in the Foundry Industry

REMOVAL of the government restrictions upon coal and coke prices had little immediate effect upon the supplies of fuel available for foundry use. Throughout the west, particularly in the St. Louis district, and around Pittsburgh, foundries have been borrowing coke from more fortunate neighboring plants to maintain operation. The same condition in general has governed in many other sections, and has been keenly accentuated where localized railway strikes have obtained.

Coke Is Higher

When coke price restrictions were removed on March 31, confusion governed for more than a week, before a semblance of a coke market was established. Foundries in general are buying sparingly awaiting more settled conditions both as to price and delivery before placing orders far in advance. Many new orders for coke since April 1, have been for car load lots. Existing contracts in some instances have been altered and extended into the third and fourth quarters, carrying higher prevailing prices. One large West Virginia producer has taken contracts for the last half of the year from all old customers at $9 per ton. Future contracts for Connellsville coke are made within the range of $10 to $12 per ton, but spot coke is sold as high as $14 and $15, Connellsville. In the New England states new prices for coke are based on $11 per ton, Connellsville, and by-product coke, produced in New England, has been contracted at from $12 to $14 per ton. Some diffidence is shown on the part of both producers and consumers with reference to entering into third and fourth quarter contracts. The former expect a reduction in price when weather and transportation difficulties are removed, while the latter are in doubt as to possible operating and coal costs covering the last half of the year.

Prices of Raw Materials for Foundry Use

CORRECTED TO APRIL 9

Iron		Scrap	
No. 2 Foundry, Valley	$43.00	Heavy melting steel, Valley	$25.50 to 26.00
No. 2 Southern, Birmingham	40.00 to 42.00	Heavy melting steel, Pittsburgh	26.00 to 27.00
No. 2 Foundry, Chicago	43.00 to 45.00	Heavy melting steel, Chicago	24.00 to 24.50
No. 2 Foundry, Philadelphia	45.00 to 46.00	Stove plate, Chicago	34.00 to 34 50
Basic, Valley	42.50 to 43.50	No. 1 cast, Chicago	42.75 to 43 25
Malleable, Chicago	43.50	No. 1 cast, Philadelphia	38.00 to 40.00
Malleable, Buffalo	46.25	No. 1 cast, Birmingham	30.00 to 31 00
Coke		Car wheels, iron, Pittsburgh	40.00 to 41.00
		Car wheels, iron, Chicago	38.50 to 39.00
Connellsville foundry coke	11.00 to 13.00	Railroad malleable, Chicago	31.00 to 31.50
Wise county foundry coke	12.00 to 12.50	Agricultural malleable, Chicago	30.00 to 30 50

Iron Output Increases

The production of pig iron during March did not show any effects of the coal and coke shortage, as was expected in some quarters. In fact the total output shown is greater than for any single month since 1918. According to **The Iron Trade Review**, the production for March was 3,375,554 tons, an increase of 391,297 tons over February. The daily average production was 108,888 tons, an increase of 5984 tons or 5.8 per cent over February. Merchant iron production totaled 859,801 tons, making a gain of 124,094 tons over the previous months. In this case, also, the daily output was larger, averaging 27,735 tons or 2372 tons per day more than February. This is equivalent to an increase of 9.38 per cent in daily output. Ten merchant stacks were blown in and four were blown out during the month showing a net gain of six furnaces making iron for sale.

Prices Are Stabilized

During the past two weeks, prices have remained fairly constant, although some sales to foundries have been noted, both above and below the ranges which characterize the different localities. Southern foundry iron, in general, is priced at from $40 to $42 per ton. A considerable tonnage was sold by a large southern producer to an adjacent industry at $38, but with this exception the price for southern iron has favored the higher price. Northern iron ranges from $42 to $44 a ton, base for foundry grades. One of the largest purchases consumated within the past two weeks, aggregating some 15,000 tons, was made at $42 and $43 per ton for northern No. 2 foundry. Pennsylvania pig iron analyzing from 2.25 to 2.75 silicon has sold at $45 per ton. A great many foundries have bought heavily for the last quarter, and the total sales of foundry iron in March marked one of the most active months in the past year and a half. This buying movement may have some foundation in the growing belief that the last of the year will find an actual shortage of foundry pig iron. Deliveries in many instances are far behind and this will set forward some third quarter contracts into the last three months of the year. Further, the general impression prevails that an advance in freight rates of from 20 to 25 per cent may be expected about Sept. 1. This of course will increase furnace costs and will react on iron prices. Foundry activity in most lines continues unabated, although steel castings manufacturers report only about 60 per cent of their capacity engaged. Railroad equipment orders are not coming forward as fast as was expected, due primarily to difficulties in financing, but some buying of cars and locomotives is reported, which in time will exert an influence on foundry activities. All classes of plumbing supplies, and castings which enter into building construction are in great demand. Automobile plants still are bending every effort to secure greater production on castings urgently needed. An opinion has been expressed that intensified sales effort resulted in an abnormal demand for automobiles during the first few months of the year, and that later this activity will taper off, and the last half of the year will see a reduction in demand for automobile castings. Nonferrous casting plants continue active. Prices on nonferrous metals, based on New York quotations follow: Copper, 18.75c; lead, 9.00c; tin, 61.50c; antimony, 10.75c; aluminum, No. 12 alloy, producers price, 31.50c and open market 30.00c to 31.00c. Zinc is quoted at 8.37½c to 8.50c, St. Louis.

Comings and Goings of Foundrymen

SAMUEL D. SLEETH, general superintendent of the foundries of the Westinghouse Air Brake Co., Wilmerding, Pa., on March 25 completed 50 years' with that company. A committee representing employes of the foundries presented an armchair and several other tokens to Mr. Sleeth in commemoration of the anniversary. Mr. Sleeth started with the company on March 25, 1870, as a molder under his father, who was the foundry foreman. He then was 18 years old and already had a fair knowledge of the trade, as he had begun work five years before, at the age of 13, in the foundry of Lewis, Ormsby & Phillips, of the Southside, Pittsburgh, and had held several other foundry jobs before joining his father's force. Mr. Sleeth remained in the ranks at the Air Brake foundry until 1887 when he was made assistant to his father. When the plant was moved from the center of Pittsburgh to a larger site at Wilmerding, Mr. Sleeth became foreman, his father's death having occurred shortly before. A few years later he was given the title of superintendent, and in 1916, when the Union Switch & Signal Co. was taken over by the Westinghouse Air Brake Co. and the foundries merged, he assumed the title of general superintendent, which he holds today. Throughout his long career Mr. Sleeth has given close attention to modern foundry methods. He originated the continuous molding process which he installed some years ago in the Westinghouse Air Brake foundries. For many years Mr. Sleeth has been identified with the American Foundrymen's association and the Pittsburgh Foundrymen's association. He served as vice president of the former and president of the latter society.

Robert Steen recently was appointed foreman of the foundry of Riehle Bros. Testing Machine Co., Philadelphia.

A. G. Williams, manager of the export department of the American Steel Foundries, Chicago, is making a trip to China and Japan to develop business for his company.

Albert Beaulie has become general manager of the Martin Brass Foundry, Providence, R. I., which he recently established. Mr. Beaulie was formerly connected with the Levis Foundry, Levis, Que.

A. P. Slater has severed his connection with the Willys-Overland Co., Toledo, and is now associated with the General Aluminum & Brass Mfg. Co., Detroit.

R. C. Robinson, formerly with the J. W. Paxson Co., has been oppointed manager of the new Philadelphia branch of the E. J. Woodison Co., Detroit, Mich.

H. L. Kirsh, formerly assistant general manager of the Western Malleables Co., Beaver Dam, Wis., now is general manager, succeeding the late Ernest E. Smythe.

SAMUEL D SLEETH

Norman L. Baker, formerly with the American Steel Foundries, East St. Louis, Ill., now has become affiliated with the Curtis & Co. Mfg. Co., St. Louis.

J. F. Geary has resigned his position as superintendent of the Thacher Furnace Co., Garwood, N. J., to become assistant superintendent of the Chicago plant of the American Brake Shoe & Foundry Co.

W. D. Fraser, formerly superintendent of the foundry of the New London Ship & Engine Co., Groton, Conn., has resigned to take charge of the General Electric Co.'s foundry at Springfield, Mass.

George H. Snyder has been appointed sales engineer for the American Steel Foundries, Chicago, with headquarters at St. Paul. Mr. Snyder has been connected with the Minneapolis, St. Paul & Sault Ste. Marie railroad in various capacities since Aug. 1, 1911.

Harry E. Richards of the St. Louis office of the United States Cast Iron Pipe & Foundry Co. has been transferred to the Chicago office to succeed John D. Capron in the sales department, the latter having become publicity manager at the Burlington, N. J., office.

M. I. Arms II was elected president and treasurer of the Aetna Foundry & Machine Co., Warren, O., at a recent meeting of the directors. The other officers of the company chosen at that time were: Secretary, M. C. Boyd, and vice president and general manager, V. E. Rehr.

Charles F. Overly recently has been appointed general manager of sales of the Structural Tool Co., Cleveland. For years Mr. Overly has been connected with the manufacture of pneumatic tools, having formed the Overly Industrial Tool Co., of which he became president. Upon the organization of the Structural Tool Co., the two companies were combined.

O. J. Smith, vice president of the Ohio Steel Foundry Co., Lima, O., on May 1 will take an important position with the Willys Corp., with headquarters in New York City, having resigned his present connection April 1. After a month's vacation, he will become attached to the Willys Corp.'s department of operation, directly under the vice president and general manager. His particular work will be systematizing plant operations.

C. Andrade Jr. has resigned as secretary and treasurer and has retired from the board of directors of the Matlack Coal & Iron Corp., New York. Lieut.-Col. Paul Debevoise, formerly secretary and treasurer of the Debevoise-Anderson Co., Inc., has been elected to the board of directors and made secretary and treasurer of the Matlack Coal & Iron Corp. He will devote his entire time to its affairs. The officers and directors of the corporation now are as follows: President, Roy A. Rainey; managing trustee, W. J. Rainey; vice president, Scott Stewart; vice president and general manager, Howard C. Matlack; secretary and treasurer, Lieut.-Col. Paul Debevoise.

Annual Meeting of the Gear Manufacturers

"Standardization in the Manufacture of Gears" is one of the important subjects to be discussed at the fourth annual meeting of the American Gear Manufacturers association, which will be held in the Hotel Statler, Detroit, April 29, 30 and May 1. An entire day of the convention will be devoted to the various angles of this subject, and reports will be given by committees which have had it under consideration for months. An interesting program has been arranged which will include papers on such subjects as "Gears from a Purchaser's Standpoint," by D. G. Stanbrough, Packard Motor Car Co., Detroit; "Routing of Gears and Machine Parts Through the Factory," by J. A. Urquhart, Brown & Sharpe Mfg. Co., Providence, R. I.; and "The Science of Manufacturing," by Henry M. Leland, president, Lincoln Motors Co., Detroit. A visit to the plant of the Ford Motor Co. is on the program of the convention. At the annual banquet to be held on the evening of April 30, F. W. Sinram, president of the association, will be toastmaster, and Edgar A. Guest, of the Detroit *Free Press*, and Henry W. Leland, president of the Lincoln Motors Co., will be the principal speakers.

Will Hold Safety Meet

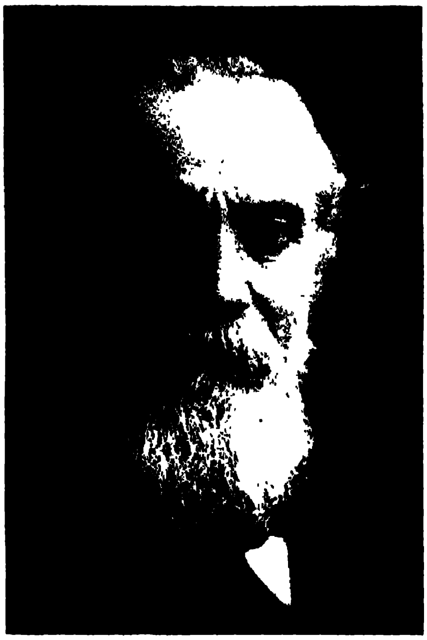
A number of the engineers who are foremost in accident prevention work and in engineering education are on the program of the first spring meeting of the engineering section, National Safety council, to be held in the Engineering societies building in New York on April 27. The relation between safety and engineering and the engineer's place in the modern industrial world will constitute the motif of the program. C. P. Tolman, chairman, manufacturing committee, National Lead Co., and chairman of the engineering section will preside.

Metallurgy Discussed by Electrochemists

The convention of the Electrochemical society, held in Boston, April 8, 9 and 10, was marked by the presentation of many papers of interest to foundrymen. The program included: "The Problem of Determining Graphitic Carbon," by W. A. Selvig and W. C. Ratcliff; "Carbon in Iron," by T. D. Yensen; "Influence of Enclosed Slag on the Corrosion of Wrought Iron," by L. T. Richardson; "The Manufacture of Ferroalloys in the Electric Furnace," by C. G. Gibson; "Properties of Ferrosilicon," by F. A. Raven; "The Electric Furnace as Applied to Metallurgy," by Clarence J. West. The convention was held in conjunction with the convention of the Electric Furnace association, and the American Institute of Electrical Engineers.

John Jeppson, Pioneer in Abrasives is Dead

John Jeppson, superintendent and one of the founders of the Norton Co., a pioneer Swedish resident of Worcester, Mass., and a leader of national reputation among the people of Swedish descent, died in the Plaza



JOHN JEPPSON

hotel, Havana, Cuba, on the night of March 26, after an illness of two weeks.

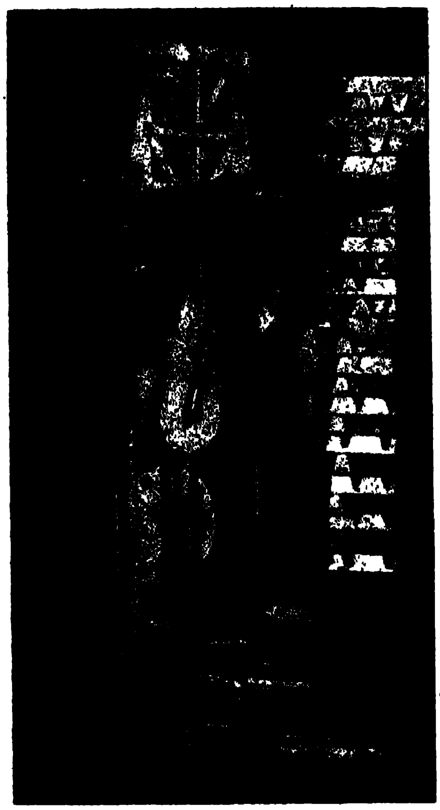
Mr. Jeppson was born on a farm near Hoganas, Sweden, July 1, 1844. At the age of 12 he went to work in a pottery shop at Hoganas. At 16 he was apprenticed as an architectural clay modeler and he worked as a journeyman modeler and potter until he was 24 years old when he decided that America offered better opportunities than prevailed in his native place. He came with the intention of finding work at his trade in Trenton, N. J., but as the potters were on strike at the time he went to relatives who had preceded him to America and who had settled in Worcester. On reaching that city, though he could not speak a word of English, he made his wishes known in German to a chance acquaintance who directed him to F. B. Norton's pottery, where his relatives were employed.

His remarkable career in Worcester began April 29, 1869, four days after he landed in New York, a poor Swedish immigrant. He worked for Mr. Norton until 1873, when he went to Taunton and was employed at his trade for four years by Wright & Co. Then he spent 6 months in Portland, working on vases and ornamental clay ware. Returning to Worcester county in 1877 he worked for Snow & Coolidge for three years. In 1880 he again entered the employ of Mr. Norton who had been experimenting with emery wheels and grinding machines. Similar experiments had been carried on by two men connected with the Worcester Polytechnic Institute. In 1884 six men including Mr. Jeppson organized the Norton Emery Wheel Co., which bought Mr. Norton's patent rights and took over the pottery as the nucleus of a plant in which to manufacture grinding wheels. Mr. Jeppson was superintendent of the grinding wheel plant from its inception and had a prominent part in the development and improvement of the firm's products. He had the active management of the Greendale plant until a few years ago, since when he has gradually withdrawn from the routine of the work, acting in an advisory capacity.

The Swedish citizens of Worcester tendered him a reception at the Bancroft hotel on Aug. 26, 1916, and presented him with a silver loving cup in honor of his services to the community. In the same year he was honored by King Gustav of Sweden who conferred upon him the insignia of the Knight of Vasa of the first class. On June 26, 1872, Mr. Jeppson married Thilda Alsthrom. Mrs. Jeppson and one son, George N. Jeppson, works manager for the Norton Co., survive.

Obituary

Chauncey G. Fleming, plant superintendent of the Wilson Foundry & Machine Co., died recently at his home in Pontiac, Mich. Mr. Fleming was a pioneer in the automobile industry. He was connected with the Wilson company for more than a quarter of a century, starting with the company when it was located in Cleveland and moving with it to Pontiac at the time of this change. He served his ap-



A TRAVELING ELEVATOR WHICH SWINGS UPON ITS OWN BASE

prenticeship at Lansing, Mich. While engaged in the trade of machinist he studied engineering and fitted himself by hard work at night for the important positions he later held in the industrial field. In his capacity of master mechanic he placed all the machinery and equipment in the factory of the Olds Motor Works, Lansing, Mich., and later superintended the placing of the machinery in the Pontiac foundry of the Wilson company.

Edward C. Welch, superintendent of the foundry department of the Norfolk & Western railway, died at his home in Roanoke, Va., March 27. Mr. Welch went to Roanoke in 1883 and accepted a position as journeyman in the Norfolk & Western shops where he finally rose to become superintendent.

Portable Radial Grinder Is Self-contained

A compact portable radial grinder designed for heavy duty and hard service recently was developed by the Mummert-Dixon Co., Hanover, Pa. The grinder, which is 3 x 20 inches, is fully self contained. The frame is mounted on a substantial base and the trunnion connected with the frame and turning in the base is supported on ball bearings. The grinding head is equipped with heavy ball bearings, as is the trolley cross shaft. Large track wheels facilitate movement on the track. By turning a crank handle which engages a worm wheel, the head may be turned through a complete circle and held at any angle. This relieves the workmen from holding the wheel at the working angle.

The steel bevel gears, having a ratio of 5 to 6, are enclosed in an oil-tight gear case packed with transmission grease. The head and motor come to a horizontal poise when released by the operator due to a weight being suspended beneath the center of the cross trolley shaft.

When carrying the machine with a crane the cross trolley is held in a central position on the frame track by a lock pin in the frame which engages the teeth of one of the trolley wheels. All of the moving parts are encased except the lower working half of the grinding wheel. The motor mounting can be adjusted to any type or style of motor. The motor controlling apparatus may be mounted on the side of the frame but on account of its being rather cumbersome it usually is mounted on a nearby wall or post.

POWER HAMMER WITH PULVERIZER FOR LABORATORY USE

Designs Special Hammer for Laboratory Use

A special pulverizing machine has been designed by the United Hammer Co., Boston, for use in chemical laboratories for pulverizing pig iron samples for analytic purposes. The power hammer, equipped with a pulverizer as shown in the accompanying illustration, will reduce ½ to ¾-inch cubes in two to three minutes so that particles are fine enough to pass through 80-mesh sieve.

The machine is arranged for belt or motor drive. The weight of the ram is 100 pounds and the machine is equipped with a 2-inch mortar and pestle. The machine is operated by a foot-treadle at the base or by the special starting device shown in the illustration. The ram is capable of striking a blow of approximately 600 pounds when the machine is operating at 300 revolutions per minute.

Revolvator Operated by Hand or by Motor

The combination truck and elevator shown in the accompanying illustration has been developed to meet an industrial condition due primarily to a lack of labor. Even where labor is available it is claimed that two men operating this device can do considerably more than a gang of men depending on their own efforts. Actual work can be performed on the floor but this machine by piling the material in tiers up to any height under the ceiling increases the available floor space which can be devoted to manufacturing purposes. The device rests on four wheels and may be pushed from place to place like any ordinary hand truck.

THE GRINDING HEAD CAN BE TURNED AND HELD AT ANY ANGLE

NET AND GROSS TON EQUIVALENTS

The following table is in common use by dealers in scrap iron and steel to convert the price of tonnage material from net to gross ton or vice versa. Its use is simple. Assuming a quotation is made on the basis of $38 per net ton, and it is desired to know the cost per gross ton. The $38 is found in the middle column and in the column to the left is found $42.56, which is the equivalent cost for a gross ton. Assuming that the $38 quotation was on a gross ton, and it is desired to know the equivalent for a net ton. The figure to the right reading $33.93 is the equivalent for the net ton.

The table may be used also to convert tonnages. Thus 100 gross tons is equal to 112 net tons, and 100 net tons is equal to 89 gross tons. This is found by reversing the manner of reading the figures for prices.

This table serves for quotations up to $50.75 per ton and for quantities up to 5075 tons.

Table of Net and Gross Ton Equivalents

Gross		Net	Gross		Net	Gross		Net
$ 1.12	$ 1.00	$ .89	6.72	6.00	5.36	12.60	11.25	10.04
1.40	1.25	1.12	7.00	6.25	5.58	12.88	11.50	10.27
1.68	1.50	1.34	7.28	6.50	5.80	13.16	11.75	10.49
1.96	1.75	1.56	7.56	6.75	6.03	13.44	12.00	10.71
2.24	2.00	1.79	7.84	7.00	6.25	13.72	12.25	10.94
2.52	2.25	2.01	8.12	7.25	6.47	14.00	12.50	11.16
2.80	2.50	2.23	8.40	7.50	6.70	14.28	12.75	11.38
3.08	2.75	2.46	8.68	7.75	6.92	14.56	13.00	11.61
3.36	3.00	2.68	8.96	8.00	7.14	14.84	13.25	11.83
3.64	3.25	2.90	9.24	8.25	7.37	15.12	13.50	12.05
3.92	3.50	3.13	9.52	8.50	7.59	15.40	13.75	12.28
4.20	3.75	3.35	9.80	8.75	7.81	15.68	14.00	12.50
4.48	4.00	3.57	10.08	9.00	8.04	15.96	14.25	12.72
4.76	4.25	3.79	10.36	9.25	8.26	16.24	14.50	12.95
5.04	4.50	4.02	10.64	9.50	8.48	16.52	14.75	13.17
5.32	4.75	4.24	10.92	9.75	8.71	16.80	15.00	13.39
5.60	5.00	4.46	11.20	10.00	8.93	17.08	15.25	13.62
5.88	5.25	4.69	11.48	10.25	9.15	17.36	15.50	13.84
6.16	5.50	4.91	11.76	10.50	9.38	17.64	15.75	14.06
6.44	5.75	5.13	12.04	10.75	9.60	17.92	16.00	14.29
			12.32	11.00	9.82	18.20	16.25	14.51

(*Concluded on Data Sheet No. 330*)

NET AND GROSS TON EQUIVALENTS

(*Concluded from Data Sheet No. 329*)

Gross		Net	Gross		Net	Gross		Net
18.48	16.50	14.73	31.36	28.00	25.00	44.24	39.50	35.27
18.76	16.75	14.96	31.64	28.25	25.22	44.52	39.75	35.49
19.04	17.00	15.18	31.92	28.50	25.45	44.80	40.00	35.71
19.32	17.25	15.40	32.20	28.75	25.67	45.08	40.25	35.94
19.60	17.50	15.63	32.48	29.00	25.89	45.36	40.50	36.16
19.88	17.75	15.85	32.76	29.25	26.12	45.64	40.75	36.38
20.16	18.00	16.07	33.04	29.50	26.34	45.92	41.00	36.61
20.44	18.25	16.29	33.32	29.75	26.56	46.20	41.25	36.83
20.72	18.50	16.52	33.60	30.00	26.79	46.48	41.50	37.05
21.00	18.75	16.74	33.88	30.25	27.01	46.76	41.75	37.28
21.28	19.00	16.96	34.16	30.50	27.23	47.04	42.00	37.50
21.56	19.25	17.19	34.44	30.75	27.46	47.32	42.25	37.72
21.84	19.50	17.41	34.72	31.00	27.68	47.60	42.50	37.95
22.12	19.75	17.63	35.00	31.25	27.90	47.88	42.75	38.17
22.40	20.00	17.86	35.28	31.50	28.13	48.16	43.00	38.39
22.68	20.25	18.08	35.56	31.75	28.35	48.44	43.25	38.62
22.96	20.50	18.30	35.84	32.00	28.57	48.72	43.50	38.84
23.24	20.75	18.53	36.12	32.25	28.79	49.00	43.75	39.06
23.52	21.00	18.75	36.40	32.50	29.02	49.28	44.00	39.29
23.80	21.25	18.97	36.68	32.75	29.24	49.56	44.25	39.51
24.08	21.50	19.20	36.96	33.00	29.46	49.84	44.50	39.73
24.36	21.75	19.42	37.24	33.25	29.69	50.12	44.75	39.96
24.64	22.00	19.64	37.52	33.50	29.91	50.40	45.00	40.18
24.92	22.25	19.87	37.80	33.75	30.13	50.68	45.25	40.40
25.20	22.50	20.09	38.08	34.00	30.36	50.96	45.50	40.63
25.48	22.75	20.31	38.36	34.25	30.58	51.24	45.75	40.85
25.76	23.00	20.54	38.64	34.50	30.80	51.52	46.00	41.07
26.04	23.25	20.76	38.92	34.75	31.03	51.80	46.25	41.29
26.32	23.50	20.98	39.20	35.00	31.25	52.08	46.50	41.52
26.60	23.75	21.21	39.48	35.25	31.47	52.36	46.75	41.74
26.88	24.00	21.43	39.76	35.50	31.70	52.04	47.00	41.96
27.16	24.25	21.65	40.04	35.75	31.92	52.92	47.25	42.19
27.44	24.50	21.88	40.32	36.00	32.14	53.20	47.50	42.41
27.72	24.75	22.10	40.60	36.25	32.37	53.48	47.75	42.63
28.00	25.00	22.32	40.88	36.50	32.59	53.76	48.00	42.86
28.28	25.25	22.54	41.16	36.75	32.81	54.04	48.25	43.08
28.56	25.50	22.77	41.44	37.00	33.04	54.32	48.50	43.30
28.84	25.75	22.99	41.72	37.25	33.26	54.60	48.75	43.53
29.12	26.00	23.21	42.00	37.50	33.48	54.88	49.00	43.75
29.40	26.25	23.44	42.28	37.75	33.71	55.16	49.25	43.97
29.68	26.50	23.66	42.56	38.00	33.93	55.44	49.50	44.20
29.96	26.75	23.88	42.84	38.25	34.15	55.72	49.75	44.42
30.24	27.00	24.11	43.12	38.50	34.38	56.00	50.00	44.64
30.52	27.25	24.33	43.40	38.75	34.60	56.28	50.25	44.87
30.80	27.50	24.55	43.68	39.00	34.82	56.56	50.50	45.09
31.08	27.75	24.78	43.96	39.25	35.04	56.84	50.75	45.31

It is described as safe, strong and durable and is built in many sizes to handle any weight of material up to 1800 pounds. Special machines are built to order for handling greater weights or to meet special conditions. A ½ horsepower electric motor operates the model shown in the illustration and the electric light circuit in many cases may provide the power required. The machines are made to be worked either by hand or electric power and the change from one form to the other can be made without delay. The revolving base makes it possible to load it from the front. After the platform is raised, the entire elevator may be revolved on this pivot base.

Oxygen In Steel

The inadequacy of different methods for determining oxygen in steel is shown in scientific paper, No. 346, published recently by the bureau of standards. Oxygen contents of acid bessemer steels deoxidized in the various ways were determined by the Ledebur method which did not indicate significant differences in oxygen contents in steels with nearly identical chemical composition and heat treatment, but having different deoxidization treatments. Neither were any differences in nitride nitrogen shown in such steels. The work of Bolyston, which is cited in the paper, showed no distinctive differences in gas content of such steels as heated in vacuum to 1000 degrees Cent.

The industrial bearing division of the Hyatt Roller Bearing Co. has been moved to 100 W. Forty-first street, New York. D. Gleisen will continue to manage the department.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The Edwin Pratt Sons Co., Charles Pratt, president, Kankakee, Ill., contemplates the erection of a foundry.

The Skinner Engine Co., Erie, Pa., plans the erection of an addition to its plant, 55 x 300 feet.

The Pennsylvania Pump & Compressor Co., Easton, Pa., plans the erection of a foundry, 80 x 100 feet.

The Strong Steel Foundry Co., 33 Norris avenue, Buffalo, has plans for a foundry building.

The Odin Stove Mfg. Co., Erie, Pa., will erect an addition to its plant, to be 2-storied, 72 x 100 feet.

Part of the plant of the Bay City Foundry & Machine Co., Bay City, Mich., recently was damaged by fire.

The H. E. Clark Mfg. Co., Atlanta, Ga., will erect a foundry and machine shop. The company was recently organized by H. E. Clark and others.

The P. B. Yates Machine Co., Beloit, Wis., has awarded contracts for the erection of an addition to its gray iron foundry, to be 100 x 200 feet.

The Summit Foundry Co, 81 Middle street, Geneva, N. Y., is reported planning the erection of an addition to its foundry, to be 60 x 150 feet.

The National Stove Co., Lorain, O., is reported planning the erection of an addition to its plant, 80 x 178 feet.

The Marion Malleable Castings Co., Marion, O., contemplates the erection of a plant addition, 60 x 70 feet.

The Kendallville Foundry Co, Kendallville, Ind., will build a foundry, 110 x 140 feet, and a pattern shop, 35 x 150 feet.

The Industrial Foundry Co., St. Johns, Mich., John Spousta, president, contemplates the erection of a plant, 100 x 135 feet.

The National Malleable Castings Co., Chicago, 2610 West Twenty-fifth street, plans the erection of a transformer house.

Additions to the gray iron foundry and the machine shop of the Beloit Iron Works, Beloit, Wis., will be erected by the Austin Co., Cleveland.

At the recent annual meeting of the Newark Stamping & Foundry Co., Newark, O., it was decided to increase the company's capital to $30,000.

The core department of the Naugatuck branch of the Eastern Malleable Iron Co., Naugatuck, Conn., recently was damaged by fire.

Capitalized at $25,000, the M. D. Jones Foundry Co., Concord, Mass., recently was incorporated by Loring N. Fowler, Frederick G. Jones and Charles H. Murphy, Laconia, N. H.

The Saco-Lowell Shops, operating several plants in New England, has taken over the Pevey Foundry Co., Inc., Lowell, Mass., and will use it as an auxiliary to the Kitson machine shop in that city.

The foundry of the H. A. May Foundry Co., Philadelphia, has been sold to a syndicate which will continue to operate it. Joseph P. Quinlan is one of those interested in the transaction.

The A. E. Martin Foundry & Machine Co., 705 Park street, Milwaukee, plans to enlarge its plant by an addition, 85 x 142 feet. New equipment includes a 10-ton crane and another cupola.

Capitalized at $10,000, the Non-Ferro Foundry & Pattern Co., Toledo, recently was incorporated by R. Eppich, H. J. Badhorn, E. G. Simon, J. Hunter and A. J. Rellinger.

Coal Economy, Ltd., Montreal, Que., has been incorporated to manufacture radiators, stoves, etc., with $200,000 capital, by A. W. Buchanan, Louis G. Prevost and others.

The Derby Castings Co., Derby, Conn., has been incorporated to make metal castings, with $25,000 capital, by C. H. Stokesbury, S. C. Conlon and J. W. Beecher, Watertown, Conn.

The Specialty Brass Co., Kenosha, Wis., has increased its capital from $25,000 to $75,000, and plans are being prepared for the erection of a plant addition.

The Independent Foundry & Machine Co., Punxsutawney, Pa., recently was incorporated with a capital of $25,000, by G. Frank Porter, August Becker and Robert J. Pollock.

A pattern shop and office building will be erected by the Standard Crucible Steel Castings Co., 717 Thirtieth street, Milwaukee. George F. Birkel is secretary and treasurer.

The Calhoun Casting Co., Battle Creek, Mich., has been incorporated with $15,000 capital, by M. J. Franklin and others to engage in a general foundry business.

The American Furnace & Foundry Co., Milan, Mich., has let contracts for the erection of a plant, 75 x 200 feet. The company was recently organized with a capital of $100,000.

George O. Partlow, Detroit, is reported planning to establish a foundry at Romeo, Mich., and is said to have asked the city to furnish a site on which to build a plant to employ 100 men.

The G. & R. Foundry Co., Terre Haute, Ind., which recently purchased the Crawford & McCrimmon Foundry & Machine Co., is erecting three additions to the foundry.

The Peoria Malleable Castings Co., Peoria, Ill., is building an addition to its foundry, in which a melting furnace and two annealing ovens will be installed.

The Peter Healey Brass Foundry Co., Evansville, Ind., has been incorporated with a capital of $50,000, by Peter Healey, Frank Schwegman and Henry B. Walker.

The Jorgenson Mfg. Co., Waupaca, Wis., has increased its capital from $70,000 to $350,000, and will erect a number of plant extensions, including a brass and aluminum casting shop. J. P. Jorgenson is president and general manager.

The Enterprise Foundry Co., Ltd., Sackville, N. B., has been incorporated to manufacture stoves, furnaces, etc., with $400,000 capital, by William S. Fisher, Robert B. Emerson, St. John, N. B.; F. A. Fisher, Sackville, N. B., and others.

The General Electric Co., Schenectady, N. Y., has leased the foundry and metal department building of the Bausch Machine Tool Co., Springfield, Mass., and is remodeling it preparatory to making iron and other castings for motor frames and large turbines.

Plans just made public by the Keystone Driller Co., Beaver Falls, Pa., for plant extensions and betterments, involve an expenditure of $200,000, and include the installation of an electric furnace and the erection of a new machine shop.

The Ingalls Iron Works, Birmingham, Ala., is fabricating steel for rebuilding the plant of the Birmingham Machine & Foundry Co., Birmingham, Ala., damaged by fire recently. Modern equipment is being installed including large planing machinery.

William A. Snow, Thornton A. Snow, Somerville, Mass., and A. L. Ruggles, recently were named as the incorporators of the Colonial Foundry & Machine Works, Inc., Boston, which was chartered with $20,000 capital.

A plant will be constructed, to be devoted to the manufacture of cast iron soil pipe, by the Emory Foundry Co., Anniston, Ala., which was recently organized. H. B. Rudisill is president and Frank Morgan secretary. The plant is expected to be ready for occupation by July 1.

A Pennsylvania charter recently was granted the Lake Erie Foundry Co., Girard, O., which succeeds the old company of the same name. The new firm is capitalized at $50,000 and was incorporated by John A. Zurn, John F. Schneider and William C. Shafer.

Consideration is being given at present to the erection of a foundry, 30 x 130 feet, this spring by Gust. Lagerquist, manufacturer of elevators, electric motors, etc. A 2-story pattern and cleaning shop building, 16 x 50 feet, and a main foundry building, 30 x 130 feet, is planned.

To do a general foundry and machine business, specializing in automobile parts, the Ryan-Bohn Foundry Co., Lansing, Mich., has been incorporated with a capital of $2,000,000, by Edward Ver Linden, Lansing; Charles B. Bohn, Detroit, and D. J. Ryan, Cleveland.

To manufacture its own castings, the Brown Hoisting Machinery Co., Cleveland, recently purchased the Elyria Foundry Co., Elyria, O. The latter company has been reorganized with the following officers: President,

Alex C. Brown; vice president, M. Pattison; secretary, George C. Wing, and treasurer, C. T. Pratt.

The North Milwaukee Foundry Co., Milwaukee, has been incorporated with a capital of $40,000, by C. G. Johnson, M. N. Federspiel, and Joseph Ewens, to establish a gray iron foundry and machine shop. A building is being remodeled and an addition, 50 x 86 feet, is under construction.

Articles of incorporation have been filed by the Middle States Foundry & Mfg. Co., Milwaukee, which is capitalized at $60,000. The company has awarded contracts for the erection of a plant, 80 x 100 feet, to be equipped for the production of gray iron castings.

The Optenberg Iron Works, Sheboygan, Wis., contemplates the erection of a foundry, 60 x 100 feet.

Articles of incorporation have been filed by the Modern Brass Mfg. Co., Schlesingerville, Wis., with a capital of $10,000. Incorporators are Otto E. Zahn and A. E. Gensman.

The American Car & Foundry Co., Chicago, has bought a site at Chicago, 370 x 1680 feet, adjoining its plant now being built. The land is covered with tracks and a few old buildings, which will be wrecked. The site will be used for storage purposes for the present, but it is understood later on will be utilized as a site for a plant extension.

The Holm's Mfg. Co., Kenosha, Wis., has been incorporated with a capital of $50,000, and is building a plant to be devoted to the manufacture of blanking and drawing dies; special tools and gages, jigs and fixtures; wood and metal patterns, etc. J. H. Holm is president; W. C. Holm, vice president and H. A. Bowman, secretary and treasurer.

Erection of a foundry, 45 x 120 feet and an erecting room, 45 x 135 feet, at the plant of the Valley Iron Works Co., Appleton, Wis., has been completed, and the structures are being equipped with overhead traveling cranes, purchased from the Milwaukee Electric Crane & Mfg. Co., Milwaukee. Practically all other necessary equipment has been contracted.

Present plans of the Emerson-Brantingham Co., Inc., Rockford, Ill., manufacturer of farm machinery, comprise the conversion of its gray iron foundry into a malleable iron foundry. This will be accomplished by the erection of an annealing room, as an addition to the present buildings, together with such other changes as are necessary to handle the production of malleable castings.

Erection of two buildings is contemplated by the Northwestern Malleable Iron Co., Milwaukee, for the manufacture of brake beams and bolsters. The first unit will be 140 x 200 feet and both will be of brick and steel construction. They are being erected under the name of the Joliet Railway Supply Co., Chicago, owned and controlled by the Northwestern Malleable Iron Co.

The Holyoke Foundry Co., Holyoke, Mass., recently incorporated with $60,000 capital, has taken over the McHugh Foundry Co. A. J. Britton, former superintendent of the Capital Foundry Co., Hartford, Conn., is vice president and general manager and Harry M. Lee, of the Bond Engineering Works, Toronto, Can., treasurer and in charge of the business management. The foundry is rented from the Holyoke Heater Co.

Building operations for the Newton Foundry Co., Newton, Iowa, recently organized with a capital of $250,000, are to start as soon as a site can be purchased. Plans call for the completion of the plant within six months. Directors are H. R. Bailey, Harry Nelson, O. B. Woodrow, H. C. McCardek, J. L. Fellows of the Grinnell Washing Machine Co., O. N. Green, C. A. Snow, Charles Greenlief and E. J. Miles.

Under the name of the Western & Eagle Mfg Corp., the Western Pattern & Mfg. Co., Racine, Wis., and the Eagle Pattern & Mfg. Co., same city, have been merged and incorporated with a capital of $50,000. The new corporation will continue the manufacture of wood and metal patterns, etc. Officers are: President and manager, Miller Peterson; vice president and assistant manager, Earle J. Aber, and secretary and treasurer, J. L. Diehl.

New equipment wanted by the Portland Stove Works, Portland, Oreg., includes stove making machinery, molding machines, nickel plating and porcelain enamel equipment, supplies, etc. This is required for a new building, 150 x 600 feet, which is 75 per cent complete, and which will double the company's present capacity. A line of pipeless furnaces are being installed and the company is interested in the purchase of furnace and stove trimmings.

The Columbiana Foundry Co., Columbiana, O., plans to increase its capital to $150,000, for the purpose of erecting a new gray iron foundry at McKeesport, Pa. Contract has been let for the foundry which will be 100 x 300 feet, and a pattern storage and office building, 25 x 150 feet. The plant will be equipped with modern foundry appliances and in addition to gray iron will produce semisteel and brass castings.

The General Casting Corp. of Pittsburgh, plans the erection of a foundry on a 4-acre site at Glenshaw, Pa. Small iron, steel and nonferrous castings up to several tons will be manufactured. The building will be 80 x 182 feet, and will be modernly equipped. Those interested in the company are W. V. Holfen, W. E. Tompkins, R. W. Hervey, George J. Frank and John W. O'Donnell, the latter of 5116 Carnegie street, Pittsburgh.

Owing to the pressure of increased business, the Emery Steel Co., 210 North Garrison lane, Baltimore, has found it necessary to enlarge its operations. The Emery Steel Castings Co., 905 Continental building, Baltimore, has been incorporated with a capital of $200,000 to take over the old plant. Property has been purchased, 73 x 278 feet, on which three buildings are located, and these will be improved. A small electric furnace with a daily capacity of three tons of small castings, weighing from a few ounces to 10 pounds, is being installed. L. J. Emery is general manager of the company.

New Trade Publications

ZINC—The New Jersey Zinc Co., New York, is circulating a folder containing what it terms the seven essential points on forming rolled zinc, and which it states will be of material aid to the metal worker.

UNION FITTINGS. The E. M. Dart Mfg. Co., Providence, R. I., has published an illustrated booklet in which pipe fittings are described and illustrated. The booklet gives various data, including specifications and a complete description of the various fittings.

TRUCKS. An illustrated booklet of 28 pages has been published by the Cowan Truck Co., Holyoke, Mass., in which the various plants in which industrial trucks can be used are shown. The plants include, foundries, machine shops, warehouses, printing plants, pattern shops, core rooms, etc.

ABRASIVES.—A bulletin has been published by the Standard Equipment Co., New Haven, Conn., in which abrasives, suitable for various work, are described and illustrated. These are angular grit, chilled shot, flint shot and Long Island sand. The first two are metal abrasives while the latter two are sand.

ZINC SOLDERING. The New Jersey Zinc Co., New York, has issued a booklet which gives practical information on zinc soldering, and embodies several details that the metal worker will find of value. These data were compiled by the company's rolled zinc division to satisfy numerous requests for information on the subject.

RECORDING INSTRUMENTS. Power factor recorders are described and illustrated in a booklet recently published by the Esterline Co., Indianapolis. The data given is complete, and is supplemented by a number of interesting chapters on the "Low Power Factor and Its Evil Effects"; "Causes of Low Power Factor and How to Locate and Remedy Them," etc.

POLISHING MACHINES.—A small 4 page folder has been published by the St. Louis Machine Tool Co., St. Louis in which polishing machines are described and illustrated. Specifications are given. The countershafts furnished with these machines have self-oiling bearings, self-oiling loose pulleys with hub two inches longer than the face projecting equally on each side.

STEAM TABLES.—The fifth edition of a booklet entitled, *Steam Tables for Condenser Work*, has been published by the Wheeler Condenser & Engineering Co., Carteret, N. J. This is a booklet of steam tables, with pressures below atmosphere expressed in inches of mercury referred, and includes a discussion of the use of the mercury column, the errors in such measurements and gives constants and tables for correcting vacuum column and barometer readings.

MECHANICAL STOKER.—The Under-Feed Stoker Co. of America, Detroit, recently published a 32-page booklet in which a mechanical stoker for industrial furnaces is described and illustrated. According to the booklet, the operation of this stoker requires every particle of coal and gas to pass upward through a bed of incandescent fuel. Air under pressure is admitted just below the fire zone. The stoker is described in detail and a number of actual installations are given.

AIR COMPRESSORS. The Union Steam Pump Co., Battle Creek, Mich., has issued a booklet in which enclosed type, splash oiling air compressors are described and illustrated. The frames of these compressors are of massive proportions, with metal properly distributed to give maximum strength and rigidity. All bearings are lubricated by the splash system. Connecting rods, which are I-beam sections, are high grade steel. Other details are given, including specifications, etc., and the various parts of the compressors are illustrated.

AIR COMPRESSORS.—An illustrated 8-page booklet has been published by the National Compressed Air Machinery Co., Los Angeles, in which vertical type air compressors are described and illustrated. The frames of these compressors are heavily constructed of close-grain gray iron, heavily ribbed; cylinders are cast en bloc, the upper half being counterbored to receive the piston, while the lower half forms the cross head guide. The cylinder heads also are cast en bloc; valves are of the disk type; pistons are close-grain gray iron, and the crankshafts are open hearth steel. Details of construction are given.

UNLOADERS AND CONVEYORS.—The Columbus Conveyor Co., Columbus, O., has prepared a booklet in which automatic unloading and conveying machinery, designed for unloading materials from hopper bottom cars, is described and illustrated. According to the booklet, with the use of a reciprocating feeder under the railroad track, a continuous bucket elevator and an all-steel drag conveyor, coal, coke and other material can be deposited at points of consumption with great reduction of labor. The character of the equipment is shown as are a number of typical illustrations. According to the booklet, a large stand outfit will unload a 50-ton hopper bottom car in 45 minutes.

AXLES.—One of the most elaborate contributions to trade literature published so far this year, is a booklet recently issued by the Clark Equipment Co., Buchanan, Mich. The first chapter of the booklet is devoted to telling of the development of the automotive axle, and some interesting data is given. The second chapter describes the plant equipment, and succeeding chapters describe the personnel of the company, its engineering department, purchasing, metallurgical department and machine, inspecting and assembling departments. The back part of the booklet contains specifications and line drawings of the axles which the company manufactures. Supplementing the descriptions are a number of colored pen etchings made by W. M. Young, at the plant.

The FOUNDRY

Volume 48. No. 10
Whole No. 347

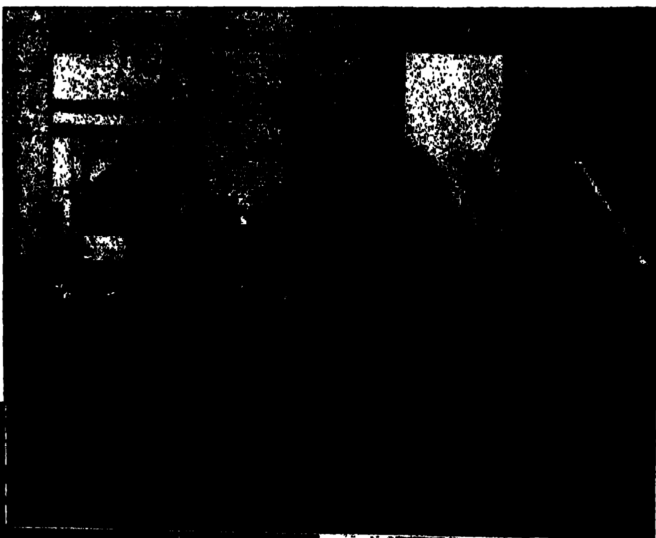
Published
Semimonthly

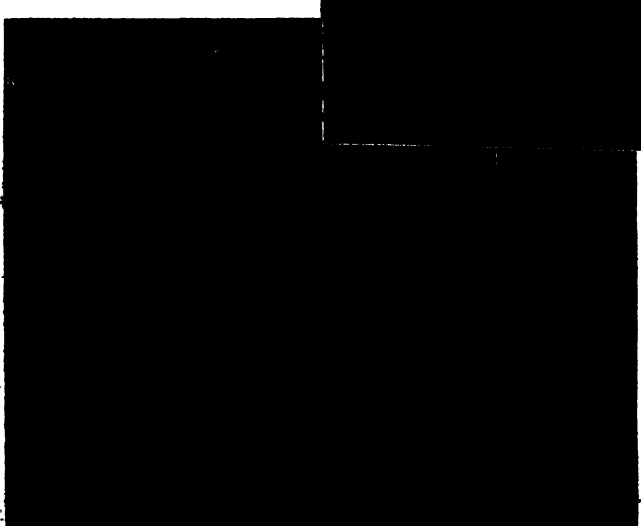
CLEVELAND, OHIO, MAY 15, 1920

How Machine Castings Are Made

Extensive Mechanical Equipment Has Made It Possible to Produce Castings Conforming to the Severe Specifications of This Class of Work With Unskilled Labor

THE Modern Foundry Co., which operates a large establishment in Oakley, a suburb of Cincinnati, is all that the term implies. It represents the best modern practice in that it has designed, built and equipped a plant to operate to a large extent mechanically, and with a minimum of skilled labor. The multiplicity of features involved in making molds and cores which under ordinary conditions require skill and training on the part of the workmen have been divided into a number of groups and unskilled labor has been trained in a short time to perform the simplified duties. Furthermore, if one workman or a group leaves the company's employ, it does not seriously hamper production. There is no waiting to secure the services of highly skilled men to replace them nor is it necessary to train green men to a point where their services are valuable. In justice to the company, it should be pointed out that this latter feature is only a secondary consideration. The policy of the company as exemplified and carried out by W. M. Kelly, the general superintendent, insures to every man a square deal, ample compensation according to his efforts, and pleasant, congenial surroundings. This has resulted in a low labor turn-over. Following the general plan of system and standardization the molds are classified according to size and each group





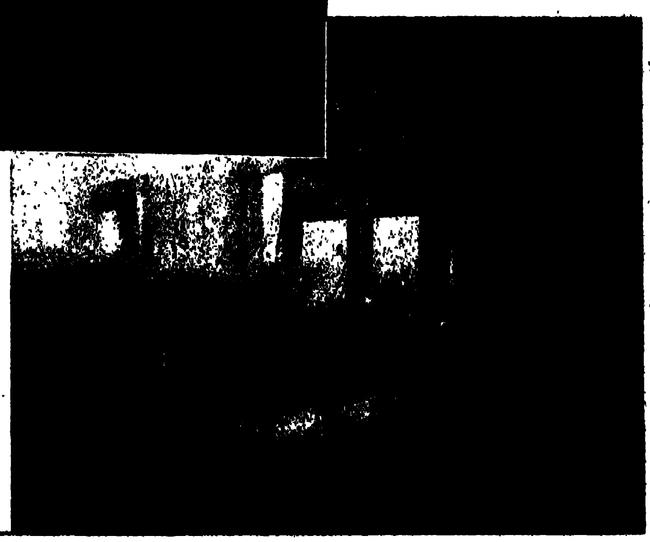


FIG. 1—THE FLASKS ARE SET ON SPECIAL PLATES TO WHICH THE PATTERNS ARE ATTACHED FIG. 2—SEVERAL FLASKS ARE PLACED ON THE TABLE OF THE JOLT RAM MACHINE AT ONE TIME FIG. 3—AFTER THE MOLDS ARE TAKEN FROM THE MACHINE THEY ARE SET ON THE FLOOR, FINISHED, BLACKED AND MADE READY FOR THE OVEN

FIG. 4—THE SAND IS SHAKEN OUT IN THIS BAY, RECONDITIONED AND LOADED IN THE STANDARD RAILROAD CAR WHICH OPERATES ON A SHORT LENGTH OF TRACK ACROSS THE ENDS OF THE TWO ADJOINING BAYS—THE EMPTY FLASKS ARE RETURNED TO THE MOLDING FLOOR BY THE SAME CAR

is segregated and handled as a unit. For this purpose the foundry is divided into several bays adjacent to each other and approximately 40 x 200 feet.

Taking them in the order in which they come, the first two bays are used exclusively for the production of molds which can be made in snap flasks. These are molded on squeezer machines supplied by the Osborn Mfg. Co., Cleveland. The next bay is equipped with two power jolt-ram, roll-over, pattern-draw machines. One of these is placed at each end of a common track which extends across the front of a number of floors which are spanned by air operated traveling cranes. This bay is devoted principally to the production of cone pulleys and other castings of a like character which require the services of deep drawing pattern devices. The molds are made on the machines at each end of the track. Each machine is served by a low truck which receives the mold after it has been rolled over. The truck is then pushed along a track until it is directly in front of the floor designated for this class of work. Here the mold is picked up by a light 2-ton crane, one of which operates over each floor, and set down in its appointed place. These cranes also are used to pour the iron, shake out and pile the flasks and load the castings on the electric trucks which form an important part of the shop equipment.

The fourth bay is given over to the production of dry sand molds. The cupolas are located at one end of this bay and a transfer track for handling the sand at the other; but all the remainder of the floor area is devoted to the different operations necessary in the production of castings by the dry sand method.

Castings Are Symmetrical

The castings for machine tools, to a considerable extent are symmetrical and it is necessary to part the patterns in the center longitudinally and make one-half in the drag and the other half in the cope. In the Modern foundry each half pattern is mounted on an individual plate which has been planed perfectly true and is provided with center and guide lines to assist in locating the patterns. The holes for the pins on these plates which are employed for locating the flasks are situated on the main center line and were drilled through the same jig that was employed in locating the pin holes in the flasks.

The molding operations are started near one end of this bay. A number of pattern plates on which patterns are mounted, are set on the floor. The flasks, provided with bars in the cope and drag and having planed joints then are lowered onto the respective parts. The gate pins, rods, gaggers or vent pipes having been set the flask is filled with sand from a grab bucket suspended from one of the three Pawling & Harnischfeger Co., cranes which operate in this bay. All of the molds are rammed on a plain jolt-ram machine having a table 6 x 8 feet. As fast as the flasks are filled they are taken over and placed on the ramming machine two or three at a time. Having been jolted the required number of times, the top is rammed with the butt of a pneumatic rammer, after which the excess sand is scraped off. The molds then are lifted, turned over and set down on the next floor where they receive the necessary finishing at the hands of a few skilled molders. From there they are taken to the ovens and next day are removed, cored

FIG. 5—THE SAND IS STORED IN THE BINS SHOWN IN THE BACKGROUND. IT IS LOADED IN THE BOXES BY HAND AND CONVEYED TO ANY PART OF THE FOUNDRY BY LIFT TRUCKS OR BY CRANES

and closed by workmen who do nothing else and therefore have developed a speed and accuracy in this work.

The sequence of operations described has brought the molds to the opposite end of the bay and in close proximity to the cupolas where they are poured. Shortly after the molds are poured, they are carried into an adjoining bay which is separated from the others by a brick wall extending from the floor to the ceiling on both sides. This bay is not so wide as the others. It is used as a shake-out floor, for the dry sand molds, and in addition to helping keep the sand confined while it is being screened, tempered and reconditioned, one section of the bay is occupied by check for the man doing the firing.

The sand from all the dry sand molds is shaken out in one pile and the flasks are piled alongside the walls in this bay. A huge permanent A-shaped screen is set up near the sand pile and all the sand which is fit to use again is passed through this screen by the simple expedient of lifting it in a grab bucket and letting it fall over the apex of the screen. The lumps of hard sand, gaggers, scrap, etc., all roll to the bottom on the outside and are taken away at regular intervals. The riddled sand between the wings of the screen is collected by the grab bucket when a sufficient quantity has accumulated and loaded into a standard railway gondola car on a short section of track across the ends ingenious device attached to the grab buckets operating at various points in the Modern foundry is an independent control for regulating the opening and closing of the two jaws of the bucket. With this device it is possible to deposit part of the contents in several flasks. The bucket can be opened to its full extent and the entire contents dumped as in ordinary practice, or it may be opened part way, a small quantity allowed to trickle out and then closed and the remainder of the load dumped elsewhere.

The sixth and last remaining bay is the same length as the others but somewhat wider. It is equipped with three jar-ram, roll-over, pattern-draw machines made by the Osborn Mfg.

FIG. 6—THE CORES ARE TURNED OUT ON HEAVILY RIBBED PLATES WHICH ARE BUILT UP THREE OR FOUR TIERS DEEP ON THE SUBSTANTIAL CORE CARRIERS SHOWN—LIFT TRUCKS ARE EMPLOYED TO CONVEY THESE LOADS OF CORES INTO THE OVENS FIG. 7—AFTER THE CORES ARE DRIED THEY ARE TAKEN OFF BY THE CRANES AND LOADED ON WOODEN PLATFORMS—THE ELECTRIC TRUCKS PICK UP THE PLATFORM WITH ITS LOAD OF CORES AND CARRIES IT WHEREVER IT IS NEEDED

the four drying ovens. The fire box for these ovens is situated at one end of the battery and the heat from the coke fire is drawn through a long brick chamber extending across the front of the ovens below the floor level. Damper plates are provided in the passage leading to each oven so that it is feasible to heat one or more single ovens or the whole battery at one time. The gas exhaust openings from each oven are situated in the side walls near the floor and are connected to a long flue which extends along the back of the ovens and terminates in a suction fan which delivers the gas to the smoke stack. Each of the individual openings leading to the main flue also is provided with a damper plate so that it is relatively easy to maintain an even temperature. Recording pyrometers, one at the back of each oven, serve as a guide and of the bay in which the sand is mixed and the bay in which the sand is filled into the flasks. When the car has been filled with sand, a load of empty flasks is placed on top and also sent into the molding bay. A long cable attached to the car at each end and running through sheaves anchored to *dead men* in the floor is used for pulling the gondola back and forth by attaching a loop in the end of the cable to the hook of the crane.

A 6-foot muller-type pan made by the National Engineering Co., Chicago, is situated close to the screen and discharges facing sand through a doorway in the wall separating the sand mixing bay from that in which the molding takes place. This is shown at the left in the back ground, Fig. 1. The facing sand accumulates in a pocket below the floor level where it can be reached by a grab bucket suspended from the crane. An Co., Cleveland. Each machine is a different size and capacity and the work is arranged so that the flasks most suitable to each machine are piled near it. The largest machine takes flasks up to 6 feet in length; the next size accommodates flasks up to 5 feet; and the smallest machine will handle anything up to 4 feet long. The machines are spaced at equal distances along one side of the bay and the molds, as fast as they are made, are taken away and set down in rows by three Pawling & Harnischfeger 5-ton cranes. The patterns used in this bay all are mounted on pattern plates or boards in a manner similar to those already mentioned when commenting on the equipment employed in the bay where the dry sand molds are made.

Since dry sand cores enter so extensively into the molding of boring mills, milling machines, radial drills

and other machine tools, it is only natural to find that the core department in the Modern foundry occupies a large space.

Views taken from three points in the coreroom are shown in Figs. 5, 6 and 7. A smooth concrete floor facilitates the use of an automatic lift truck which is used for carrying the cores from the point where they are piled after being taken off the core carriages, to the molds in the different parts of the foundry. Considering the core making process in the regular sequence of operations, the first item of interest is the row of sand storage bins partly shown in Fig. 5. These extend across the entire width of the building. A wide and roomy gangway separates the sand bins from two sand mixing machines; one a rotary paddle type made by the Blystone Mfg. Co., Cambridge Springs, Pa., used principally for making oil sand mixtures; and the other a 6-foot pan of the muller type supplied by the National Engineering Co., Chicago.

Standard core making methods are observed in setting arbors, rods, hooks and in making vent passages, but no cores are hand rammed, and none turned out on crooked or warped core plates. As already stated, three machines are used for making all of the larger cores. One of these machines is located at the end of the bay shown in Fig. 7. The other two, which are smaller, are situated in the side bay to the right.

The cast-iron core plates are heavily ribbed on the back to insure rigidity and the face which comes in contact with the core in all cases is planed absolutely true. The plates are provided on the back with two staples for convenience in handling when putting them on the coreboxes. After the cores are rammed and turned out on the plates they are blacked and loaded on the stands, in the manner indicated in Fig. 6. The stands are stiff rectangular frames resting upon two parallel supports. As soon as a stand is loaded one of the lift trucks

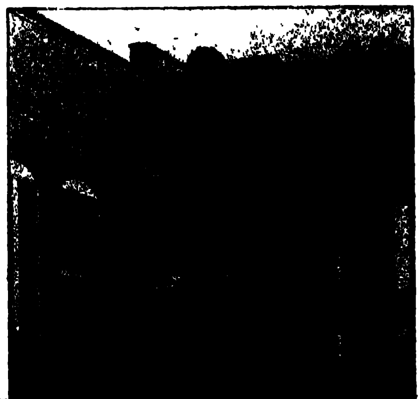


FIG. 8—THE IRON CHARGES FOR THE CUPOLA ARE MADE UP ON WOOD PLATFORMS REINFORCED BY AN IRON BAND AROUND THE TOP AND SEVERAL IRON BRACES AT THE ENDS AND SIDES—THEY ARE CARRIED TO THE CUPOLA ELEVATOR BY AN ELECTRIC TRUCK WHICH HAS A SCALE INCORPORATED IN THE LIFTING PLATFORM

Various standard mixtures are made in the latter. Sand is cheap and plentiful in the vicinity of Cincinnati and advantage is taken of that fact to use a maximum of loam sand in the mixture and a minimum of artificial dry binder.

After the core sand has been mixed it is taken, in the boxes shown in Fig. 5, to the three Osborn jar-ram, roll-over, pattern-draw machines. These boxes are handled by the truck as may be seen by referring to Fig. 5, or they may be transported by the crane. When the crane is employed, chain hooks are attached to the eyes in the triangular iron braces bolted to the sides of the boxes.

is slipped in under it and it is conveyed to the oven and set on the floor. Four ovens, 6 x 6 x 10 feet, fired with natural gas are employed for drying the cores. A small blower made by the Connersville Blower Co., Connersville, Ind., driven by a 10-horsepower Allis-Chalmers motor is used to exhaust the waste gas and create a circulation of heat in the ovens. The same fan performs a like service for the ovens upstairs in the girls' coreroom; which will be described later.

After the cores are dried the rig shown suspended from the crane in Fig. 7, is employed to lift them off the cars. This device consists of two pairs of cam hooks attached to a pair of sling chains. The hooks are made of 3 x ¾-inch flat bar iron. The toes at the lower ends are bent to engage the plates. Slightly higher on the shank they are bent at an obtuse angle to prevent them from pulling in and jamming the core when the core and plate are suspended from the crane. A small gas fired drawer-type oven situated near the large ovens is used for drying the round stock cores which are made on a Wadsworth core machine mounted on a bench nearby. This oven also is employed to dry the hand ladles used by the men engaged in snap work. These hand ladles are provided with a self skimming device consisting of a partial hood across the top of the ladle with a hole through it which allows the metal to pass.

All of the small cores with the exception of the stock cores already mentioned are made in a specially equipped coreroom situated over the sand bins. This second-story coreroom is served by an elevator which carries sand and other supplies up, and racks and boxes full of cores down. This coreroom is a complete,

self-contained unit and is "manned" entirely by women. None of the work is heavy and to make the conditions still more agreeable, and lighten the physical exertion, the superintendent recently substituted aluminum core plates for the cast iron plates formerly in use. The core benches are situated closely around the wall while the core ovens of the gas-fired drawer-type are in the center of the floor. There is ample heat, light and ventilation.

Preparations now are under way for greatly increased tonnage. To assist in this, the company will install a large jolt-ram, roll-over, pattern-draw molding machine made by the Osborn Mfg. Co., Cleveland, capable of handling molds weighing up to six tons. A new cupola made by the Whiting Foundry Equipment Co., Harvey, Ill., also will be added. The cupola design has been changed considerably and several interesting features added at the instigation of the superintendent who also has designed and installed an elevator system to facilitate charging the new cupola.

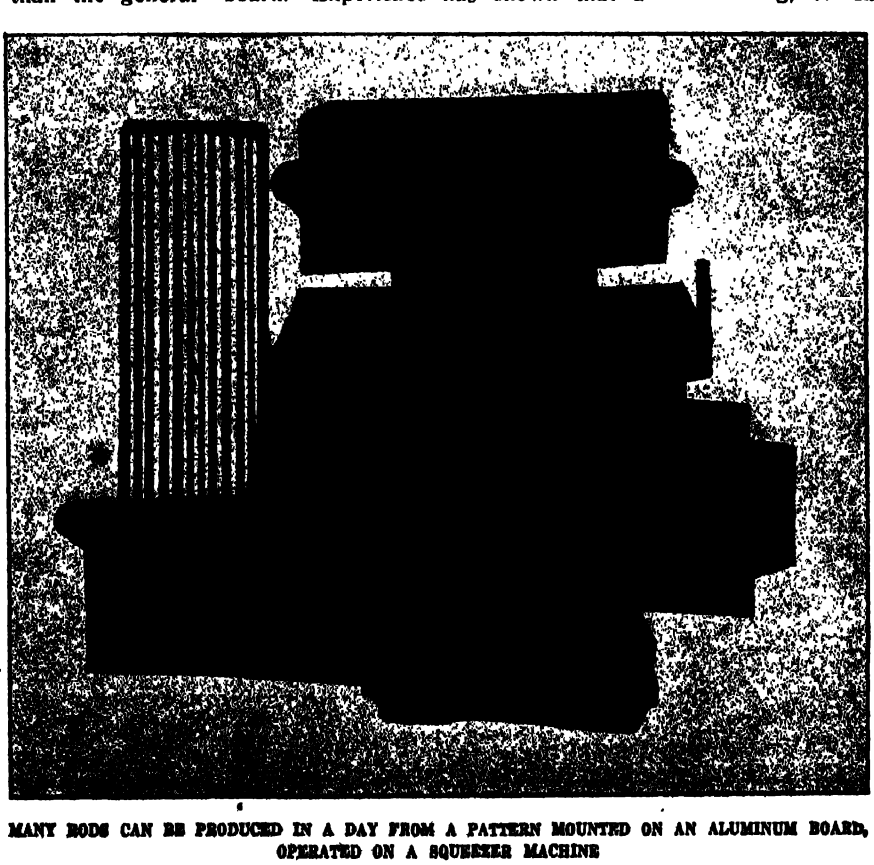
The daily heat at present ranges between 80 and 90 tons and this is taken care of by a Whiting cupola lined to 60 inches. The blast is furnished by a positive pressure blower made by the Connersville Blower Co., Connersville, Ind., and capable of delivering 40 cubic feet of air per revolution. It is driven at a speed of 200 revolutions a minute by a 40-horsepower Allis-Chalmers motor. This results in the delivery of about 500,000 cubic feet of air an hour. The iron is melted at the rate of 15 tons an hour. The composition of the charges vary occasionally but an average 4000 pound charge consists of 1800 pounds of pig iron and 2200 pounds of scrap. Steel scrap is used in amounts varying from 5 to 20 per cent.

Wooden platforms like those shown in Fig. 8, are used to handle iron. They are placed in the stock yard near the piles of iron and loaded. An electric truck made by the Automatic Transportation Co., Buffalo, N. Y., and having a scale table is employed to lift and carry these platform boxes to the cupola elevator. When the elevator reaches the charging platform another truck is employed to carry the loaded frames to a favorable charging position near the cupola. Coke is loaded in cans which hold 70 pounds each and the contents of five cans is spread between the successive iron charges.

How to Make Cast Iron Welding Rods

NEARLY all gray-iron foundries which weld their castings purchase the welding rods instead of casting them. Two requirements stand in the way of the foundry man who wishes to make his own welding rods. The one is the high expense of adequate equipment compared to the limited demand for the product by a single foundry. The other is that an iron is required which is higher in silicon than the general run of metal poured by the foundry. The silicon should be above 2.50 per cent, but otherwise the composition of metal may be the same as is used by the average foundry. The Gale Manufacturing Co., Albion, Mich., which manufactures welding rods for the trade and makes them of a metal having 2.60 to 2.80 per cent silicon, 0.09 to 0.10 per cent sulphur, 0.50 to 0.55 per cent phosphorus and 0.45 to 0.50 per cent manganese. This iron has proved satisfactory and does not cause hard spots in the castings. A large number of rods are produced by one molder with the aid of a pattern mounted on an aluminum plate. The pattern is made of brass rods split in two and riveted to the plate. The gate is located on the end and twelve rods are run from it, as shown in the accompanying illustration. The job is made on a squeezer machine with an ordinary snap flask and a stiff squeezer board. Experience has shown that a stiff board is necessary to take care of the strain through the center unless the plate is made unduly heavy. A medium fine sand is riddled on the pattern through a ¼-inch riddle. The molds are tilted for pouring by raising the gate end about 2 inches off the floor. The molders are taught to be careful not to force the iron into the mold too fast when pouring.

Sand on the rod will cause trouble in welding, so care is taken to see that the rods are well cleaned before shipment. Rods up to ¼-inch in diameter are sandblasted, while rods ½ or ¾-inch in diameter are cleaned in a tumbling barrel. In the former case the rods are fed by an ingenious device into an automatic sand blast cabinet where the scale and sand are removed. In the latter the rods are packed closely in a small tumbling barrel from which they emerge perfectly clean and shining. They are then graded for size and stocked for shipment.



MANY RODS CAN BE PRODUCED IN A DAY FROM A PATTERN MOUNTED ON AN ALUMINUM BOARD, OPERATED ON A SQUEEZER MACHINE

Cultivate Idea Men In Foundries

Changes and Improvements in Manufacturing Methods are Directly Traceable to Ideas Born and Brought to a Successful Issue by the Originator or Through the Co-operation of Others.

BY R. R. CLARKE

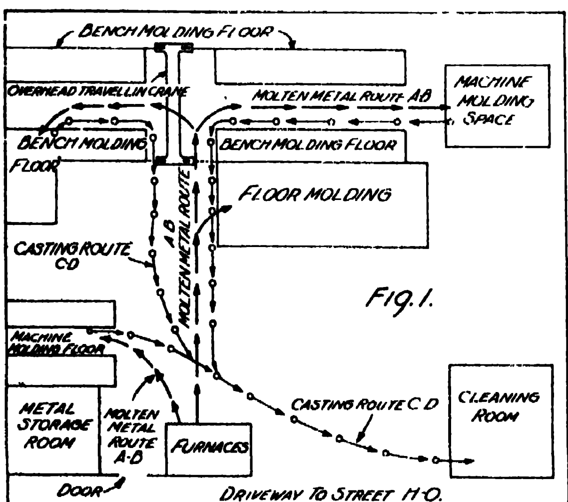
IDEAS are revolutionary forces. They mark sharp turning points in human experience and divide new from old orders. Every step of material progress was first conceived as an abstract idea which slowly crystallized in some master mind to be later brought to light and applied. Genius, invention, progress are synonymous terms for the application of ideas. Where does your business stand today, how fast, how cheaply, how efficiently can you produce? Look it over carefully and see if you don't stand exactly where the brains of your organization put you, with ideas expressed in such items as mechanical appliances and devices, pouring off systems, relative location of melting room and coreroom to molding floors, of molding floor to cleaning room, cleaning room to shipping room, and thousands of points of design. Ideas expressed further in molding machine equipment, gated-up patterns, mounted plates and all other instances where ordinary methods have been discarded for quicker and simpler systems.

The task of the idea man is to think and scheme the idea into harmony with the conditions. By way of illustration: From three patterns furnished, a foundry received an order for 100 circular brass disks, 4 inches in diameter, 1 inch thick and containing two short side lugs diametrically opposite each other. The customer pleaded for quick, cheap work. Two alternative methods are open, make three additional patterns to fill a flask or get the best results with the three patterns furnished. The idea man would tack the three patterns on a board close to one end and gate them up in such manner that he could ram or squeeze 17 drags on a molding machine, then squeeze, up 17 copes, from the same board, reverse his copes from the drag impressions when setting them on the drag. He thus would get three castings in the drag and three in the cope of the mold, or six castings from the three patterns furnished.

Criticism is Valuable

The idea man must possess originality and be broad-minded and open to suggestions and criticism. He gets an idea, it is his own and to him a seemingly perfect conception. Now if he will submit that idea to someone of unbiased good judgment and practical insight, he might go a long way toward perfection. After getting his idea well under way, if his superior official or some workman of lower rank points out some detail that could be improved, he will take the advice seriously and analyze it carefully instead of passively resenting it. Usually, the idea man is of greater value on general features than on details. He is better on conceptions then on the mechanical particulars of applying his ideas. He has others such as pattern shop foreman and machine shop foreman, to consummate his plans. It is quite obvious that to make the most of opportunity he must recognize the great value of the co-operation of these men of practical experience. In the writer's shop, we attempted to mount air port patterns a couple of years ago for machine molding and found the proposition a little puzzling due to the pattern peculiarities. We conceived a plan involving metal patterns and went over it with the machine shop superintendent, a man of decided ability. The patterns adopted include the principles of the original conception throughout, but they embody also changes in details of most pronounced value furnished by the machine-shop man.

One must keep himself well posted on up-to-date methods, and be willing to apply them to his own conditions. It is a good thing to know how the other fellow does it. After finding the other fellow's conditions identical, take his idea, improve on it and adapt it to suit the



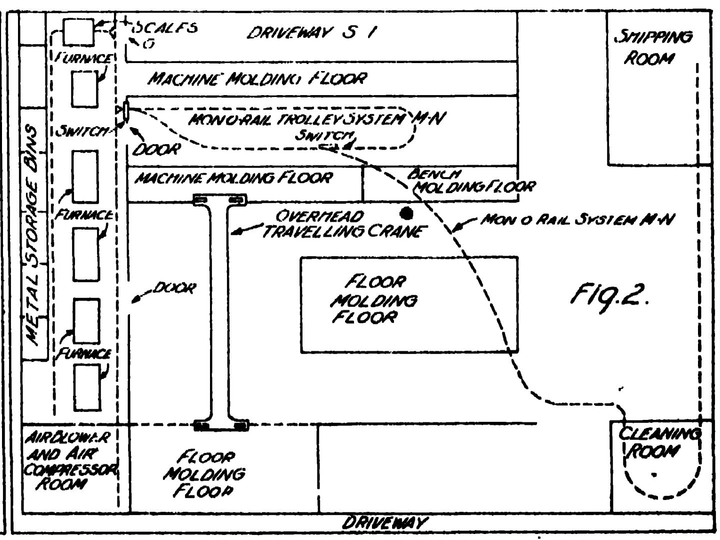


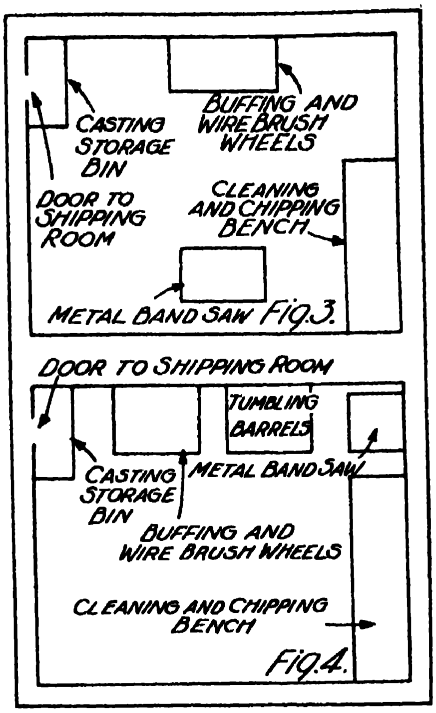
FIG. 1—GENERAL LAYOUT OF THE FOUNDRY SHOWING THE INVOLVED ROUTE TAKEN BY THE METAL FROM THE STORAGE BINS TO THE SHIPPING ROOM
FIG. 2—BY A JUDICIOUS REARRANGEMENT THE WORK HAS BEEN GREATLY LIGHTENED PARTICULARLY IN HANDLING THE METAL BEFORE AND AFTER IT HAS BEEN MELTED

circumstances. An idea man must keep in touch with methods and progress along industrial lines in general. It's a long way, comparatively speaking, from a barn to a foundry, yet many modern barns are equipped with light, commodious, monorail trolley systems that could be used to maximum advantage in a foundry. The parts of this system consist of rails, hangers, trolleys and switches capable of sustaining a 1000-pound load. They are manufactured and sold at a reasonable cost and would fit many foundry conditions perfectly. For instance in transporting and pouring off metal within their capacity there is nothing handier, cheaper or more efficient.

The idea man must carry a full stock of self-reliance and initiative. He must have self-confidence and be able and determined to go ahead unaffected by resistance. For some undefined reason the way of the progressive man always has been hard. The world ridiculed Columbus, laughed at Fulton and called Bessemer crazy. Under adverse conditions the only course is to hold fast to your convictions, keep your head level, your mouth shut and go ahead.

Impractical Methods Expensive

The idea man must be practical. Practicability is the great test and without it no idea, however perfect it may be theoretically, is worth the breath used in expounding it. The true idea man will carefully go over every detail of application and operation and satisfy his mind that the abstract conception will in its concrete and working form be practicable, simple and efficient. Occasional miscalculation is inevitable and excusable in all men, but persistency in clinging to a losing practice regardless of its limitations, from a mere sense of vanity, can find no justification under ordinary circumstances.



FIGS. 3 AND 4—CLEANING ROOM LAYOUT AS FOUND AND ALTERED

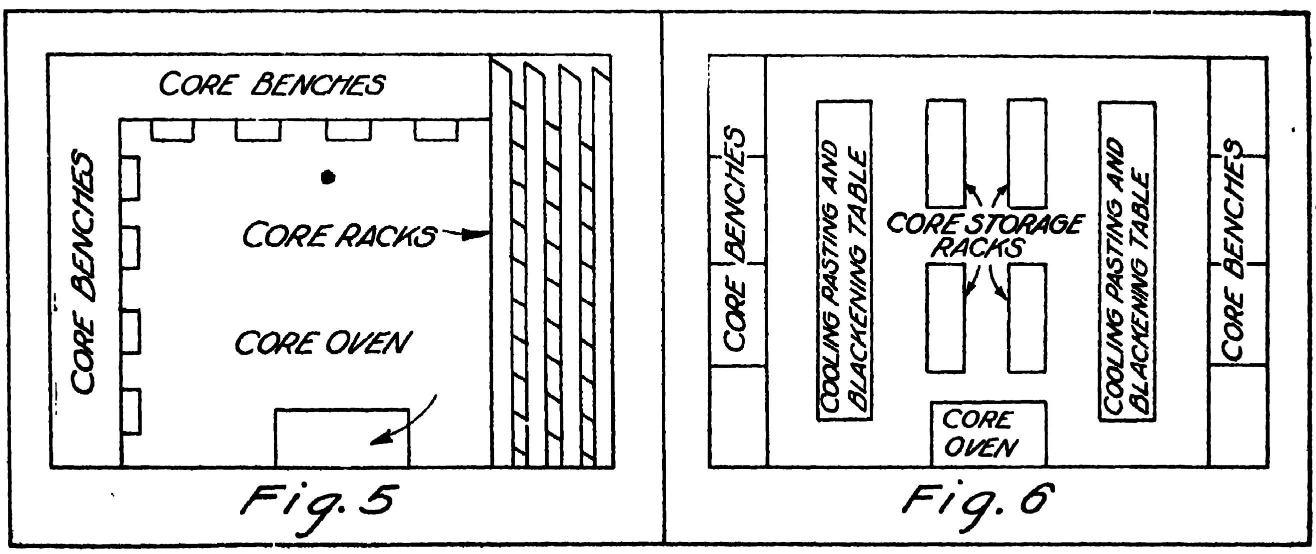
To increase and cheapen output a foundry foreman discarded the method of molding driving box shells on the flat side in favor of casting them on end. In the latter method he combined two patterns in one, using dry sand cores at first and later iron chills to separate the castings. The idea looked good to him on paper but actual practice disclosed its fallacy. He had to use a three-parted flask and make two partings. The ramming became much more particular and slow. Lifting the heavy cheek off the drag and later setting it back was drudgery requiring four men for each lift. Dressing and facing the mold was a serious handicap, and setting the additional cores consumed extra time and patience. The method was a decided failure, yet the foreman refused to abandon it and accused his molders of laying down on the job. Being a piece-work shop the men refused to make driving box shells and one by one started to quit. The situation soon became acute and forced a return to the original method.

The idea man figures closely on cost and profit. The question "Will it pay" to him is of vast significance. If an order for 1000 castings will scarcely pay for plate-mounting the patterns, he will not consider the idea; but if an order for 10,000 will pay, he will accord the plate mounting feature serious consideration. The promise of duplication, the time and output gained as compared to the initial expense, always will vitally affect plans and calculations.

Specialists Are Needed

The question might arise "When does an idea pay?" Naturally when increased output at reduced cost continues long enough to offset initial expense and yield substantial profit. If it is an even break, it is apparently useless to bother with making the change. However, suppose the change makes a task easier or gets a job out quicker or relieves congestion in another hard pressed quarter, will it pay even though no monetary saving is involved? Sometimes it may not, though often doubtless it will. The true idea man applies sound and analytic judgment to such a problem.

The best idea men are specialists. Sometimes all-around idea men fit well into those smaller concerns unable



FIGS. 5 AND 6—CORE ROOM AS IT APPEARED BEFORE AND AFTER THE IDEA MAN WAS CONSULTED

to place one in each separate department, but large concerns will find it pays to specialize. As business reaches the magnitude where the capacity of the coreroom, the cleaning room, the general foundry layout, and the molding floors, is severely taxed, brainy talent in or at the head of each department undoubtedly will yield greater results than any number of all around men.

Changing the Layout

General foundry layout embodying relative position or location of different departments is a big item. An actual case will illustrate the point. On assuming his new duties a foundry superintendent found the layout as illustrated in Fig. 1. He at once noted the illogical position of the furnaces and metal storage room and recommended a change. It will be noticed that raw material was delivered to metal storage room over driveway *HO*. From the storage room it was wheeled back to the furnaces past which it originally was hauled From the furnaces it was packed by hand over routes *AB* to the different molding floors where it was picked up by a trolley crane and poured. Over the bench-molding floors a heavy overhead, hand-operated, traveling crane moved ponderously up and down the shop and had a light but by no means convenient transverse carriage. To pour up and down the shop on light and mixed bench work was utterly impractical due to the inertia of the crane in starting and its momentum in stopping. Further, to arrange the molds transversely allowed little pouring freedom, beside necessitating stepping over the molds. After the castings were poured and shaken out they were brought back past the furnaces to the cleaning room by wheelbarrow and over routes *CD*.

The superintendent contended that raw metal should enter the shop at one end and by straight forward movement pass through the shop in its different forms until emerging in finished product at the opposite end. After considerable opposition and argument his plan was adopted as shown in Fig. 2. An addition was built at the rear of the foundry and a battery of five air and oil furnaces placed in the position indicated. Back of the furnaces and within charging distance, metal storage bins were placed. Raw material is delivered by auto truck over driveway *SI* to door *G* and there picked up by a monorail trolley, carried over the scales where it is weighed and thence to the metal storage bins.

The growth and perfecting of machine molding in this shop eliminated most of the bench molding floors which now are used for machine molding, abolishing the machine molding floor in the rear corner of the shop as shown in Fig. 1. This brought all light and medium weight flasks under the same trolley system. This trolley system is a monorail running from the molding floor back to the furnaces and continuing from the molding floors across the shop to the cleaning room where it makes a loop and stretches onward to the shipping room.

Raw material enters door *G* and over driveway *SI*. It is picked up by

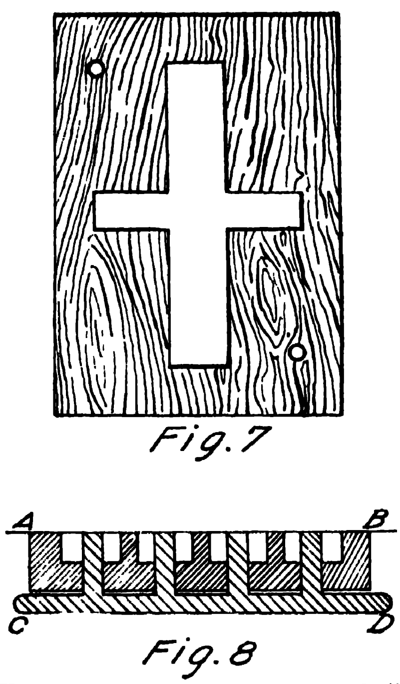


FIG. 7—HALF SECTION OF CORE BOX FOR TROLLEY WHEELS AS IT CAME FROM THE CUSTOMER FIG. 8—SECTION OF GANG CORE BOX FOR MAKING THE DISK CORE FOR THE CHAMBER IN THE TROLLEY WHEEL

trolley and set on the scale, weighed and transported direct to the storage bins back of the furnaces. From the furnaces the metal is caught in a pouring ladle hanging on the trolley and transported directly to the molding floors. Castings shaken out are picked up on a specially devised carriage which is suspended from the trolley and taken directly to the cleaning room where, after being cleaned and ground, they are picked up by the same carriage and taken directly to the shipping room. Gates accumulating in the cleaning room are thrown into an iron box which is picked up by trolley and sent back to the furnaces daily over the same trolley system. The actual benefits of this new system are so vast and pronounced as to admit of no comparison.

The change was not all due to one man's idea. The superintendent conceived the idea of general change and was responsible for the monorail system from the furnaces to the molding floors. The general manager carried the system from the molding floors to the cleaning room; the shipping clerk conceived the plan of going onward to the shipping room; while the machine shop superintendent suggested the idea of unloading raw material in addition to furnishing ideas on detail throughout.

Further Examples

Another example illustrates the value of co-operation. A cleaning-room foreman in a small foundry inherited the layout shown in Fig. 3. Castings on gates were brought to the cleaning bench, hand-brushed and delivered to the saw 10 feet to the right. Following sawing they were carried to buffing wheels and wire brush wheel 15 feet forward, and thence carried quite a distance to shipping room. Under the changed arrangement shown in Fig. 4, castings are delivered to the cleaning bench, pass to the tumbling barrels, thence to the buffing wheels and on to shipping room. The difference is too apparent to require comment.

Compare the coreroom shown in Fig. 5 with that in Fig. 6. The one indicates constructive indifference as actually found, the other representing changes resulting from ideas springing from thoughtful planning. In Fig. 5, eight coremakers worked from 10 to 30 feet from the core oven and from 5 to 25 feet from the core storage racks. They made, pasted and blackened their cores on the same bench. Fig. 6 shows the rearrangement and includes spacious tables for shifting, cooling, pasting and blackening the cores. These tables with their under bins and drawers and with the more advantageous location of stable core storage racks, represent a handiness and efficiency a hundred fold greater than the original.

The arrangement and construction of core boxes conducive to speeding up the output represents another core-room possibility. A single example follows. Fig. 7 shows a cross section of a split core box for trolley wheels as delivered by the customer. Castings were ordered in 300, 500 and up to 1500 lots. A gang or multiple core box was made to make six straight, round cores corresponding to

the axis core in Fig. 7 at one time. In Fig. 9, parts *AB CD* are separate, *AB* is a flat plate with four flat bottom holes drilled partly through it and the same size as the disk part of the core in Fig. 7. Extending through the plate and center of each hole, a smaller hole is drilled. This hole is a shade larger than the diameter of the axis core of Fig. 7. The portion, *CD*, is a flat metal plate with four parts sticking up, these parts being the diameter of the axis core and of such a height that they come flush with the top surface of *AB*, when the two parts are placed together. The disk cores are made rapidly in this composite box by ramming, rolling over, lifting *CD* off *AB* and finally drawing *AB*. At similar speed the axis cores are made separately. Both axis and disk cores then are dried after which the disk core is pasted onto the axis core at its center. The pasting is done by setting the axis core upright in a measuring form—a mere wooden block with a hole in it—dropping a little paste in the crevice between the two cores, turning the block sideways, drawing the core out and laying it on a drying rack. Arguments advanced against the method were that the core would blow because of the absence of a vent from the disk to the axis and that the bond of paste would break and permit the disk core to shift under the buoyancy of the metal. Out of hundreds of castings made, there was not a single such calamity.

Special Equipment Pays

Every foundry tool, device or appliance, every peculiarity of condition admits a possibility of novelty and improvement. In a railroad shop locomotive rod brasses had been made by ramming first the cope of a level-parting flask, rolling over, ramming the drag, rolling back and finishing. The foreman hit on the idea of a flask that would part with the journal-line of the rod brass and adopted it. This change in flask decreased the cost and increased the output of rod brasses over 25 per cent. The sides and ends of these flasks were cast separately and later assembled by bolting them firmly together. In a manufacturing plant using snap flasks, the practice always had been to nail strips of wood on the top of the cope or bottom of the drag to increase the height or depth. Patterns were made to make metal half frames, 1 and 2 inches high for the three different sized flasks in use. These half frames were cast of aluminum and uniformly drilled for screw holes after which the iron strips on the flask were drilled similarly. The aluminum frames gave a smooth, level, top and bottom surface, were interchangeable with all flasks of the same size and admitted attaching and detaching in one-tenth the time.

A foundry making a variety of small bushing cores (½ inch to 2 inches in diameter, by 16 inches long) followed the usual method of black washing the cores after drying and then laying them flat on a level core plate for delivery to the oven for the final core-wash drying. An improved device by which from 8 to 20 cores can be dried on end at one time is shown in Fig. 9. This is simply constructed. The base is cast, the stem is a ½-inch iron rod threaded on one end with a handle bent on the other The upper compartment circle is made by casting a hub upon eight wires of equal length and equidistant from each other. A wire bent to the circle is then spot-welded by acetylene to the points of these eight wires, radiating from the hub. The hub then is drilled, slipped over the stem and secured to it by means of a set screw. In use, each compartment holds from one to four cores standing at an angle to the base and leaning outward at the top. They touch the form at only two points, giving practically an unmarred core surface.

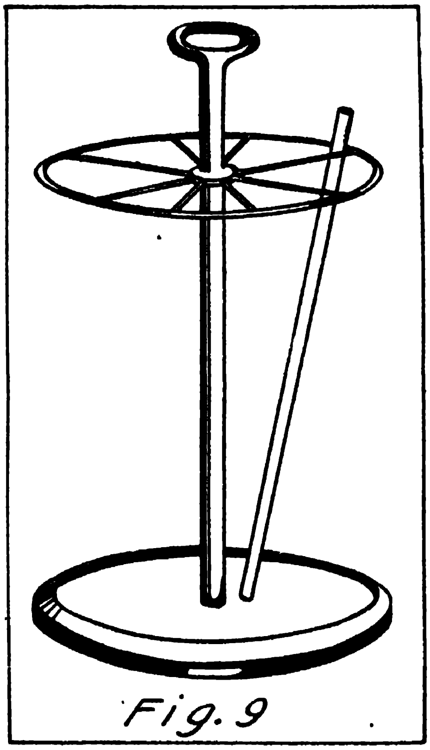


FIG. 9—HOLDER FOR DRYING STRAIGHT CORES AFTER BLACKING

Rammed-in and seamless furnace linings possess many advantages both in service and in renewal. In a barrel use a form or pattern around which to ram the lining material. However, lining a furnace of the Schwartz type, which does not part at the middle, is a different proposition. We lined such a furnace once simply by plastering the lining to the sides, attaining a fair job and average service. However, we don't do it that way now. Instead, we use a collapsible form, an idea suggested by a machine-shop man and worked out by the patternmaker.

Manufacturing a standard product offers an ideal condition for exercising ingenuity. Usually such a product justifies any reasonable outlay of capital to facilitate and increase output. The saving of a single moment of time, an ounce of metal, or measure of energy per unit of production multiplies immeasurably in the vast quantities turned out. Molding machines built to suit some specific job, flasks designed for particular purposes, pattern plates mounted by expensive and enduring methods, special pouring off, shaking out and casting conveying systems, sand mixing, riddling and conveying systems, and cleaning room equipment, offer wide fields for the inventive mind.

Choice of Methods Important

If we had just 100 and no prospect of any more 2-inch globe valve bodies and trimmings to make, we would get out a wood pattern for the body, mount it on a plate and make it on a jolt-squeeze hand drawing machine. The trimmings, we would group on a plate and make the same way. If we had 1000 to make and a guarantee of thousands to follow, we would make metal patterns. We would mount the body with stripping plate, and either buy a molding machine with power lift device or rig up the same device for use on a jolt squeeze machine. For the trimmings, we would make enough metal patterns of each kind to fill a flask, plate mount each kind separately and assign these plates to the most suitable machines.

Jobbing work is a supreme test of the foundryman's ability. It is not difficult to produce automatically close to 100 per cent on types of patterns in service month in and month out; but when the patterns are changing daily and representing all types and classes of work from all types and grades of metal the situation is entirely different. The writer's foundry has played both ends of the game and holds that successful manufacturing, despite its vastly superior showing is not to be compared with high class jobbing. Genius in jobbing is of a different and higher order because the conditions are so widely

harder. This probably explains why the average jobbing shop observes ordinary methods and expresses little if any of that progressive spirit so vital to up-to-date manufacturing. Therefore, the idea man in a jobbing shop must be a different and higher type. He must have knowledge, broad vision, sounder judgment, great discriminating powers, pronounced originality and self-reliance, and quick, accurate decision. Neither time nor conditions admit of much experiment; while limited quantities reduce margins of expenditure for equipment and changes. What he tries must be comparatively inexpensive and work from the beginning or a loss is suffered which takes all the profit. So peculiar indeed are his conditions that a manufacturing foundryman changing over to jobbing must forget much of his training and discard many of his principles.

Making Bushings on End

Another field too large to admit of more than a single illustration is that of arranging core prints. Suppose in small orders frequently recurring a variety of 12-inch bushings ranging from a ½-inch to 2-inch cores and from 1-inch to 3 and 4-inch outside diameters, are made. The differential in sizes of both cores and outside dimensions being, say in eighths of an inch. Usually it is desired to pour them on end to keep the core straight and centrally located, molded flat and poured upright, in open end flasks. That necessitates a great number of each sized patterns to accommodate the different sized cores, so the plan is offered of making all patterns with a ½-inch diameter core print and using slip-over liners or bushings to give any diameter desired. This plan will work but at a tremendous disadvantage so it is decided to use solid patterns with detachable end prints, and mold and pour on end. Perhaps this is because the shop has a jolt machine where the ramming can be done quickly and admirably. Despite the best efforts, cores get out of center due, sometimes, to slight shifts in the flask or the core prints and often to the cores mislocating more or less in closing the cope of the mold over them. Fig. 10 shows a circular disk core ½-inch thick and having a center hole ½-inch diameter. It also shows a pattern for pin brass 12 inches long with a ½-inch core print attached to bottom and disk core print attached to the top. Mold a pin brass from this pattern. Take a ½-inch round core 14 inches long and set it in the drag print. Then slip a disk core over the top end of the round core and press it nearly into its own print and the last reasonable chance of the core coming out of center is avoided. If a ¾-inch hole in the bushing is wanted, use a ¾-inch drag print and make the hole in the disk core also ¾-inch instead of ½-inch and similarly for any sized bushing with any sized core. These disk cores can be made cheaply from one or two gang core boxes. They may be used on the bottom print by slipping them over the core print in ramming up.

At one time, nonferrous alloys were chiefly one of two combinations, copper and tin or copper and zinc. We now have copper base alloys containing from 2 to 6 elements in widely varying proportions. Few brass foundries work the same alloys in the same way and yet many of them get clean metal and solid castings. As a final and conclusive test of the pouring temperature of phosphor bronze we could always rely safely on the appearance of the metal in the sprue head. Though able to judge well by color, viscosity, etc, yet we sometimes were mistaken in these signs. Pouring molds ordinarily prepared, with the metal at too high temperature meant severe sand burning. Pouring too cold produced dull and shrunken castings. We early conceived the idea of preparing at least two molds for metal slightly high in temperature and set these molds at the head of the line. We then would pour these molds with the metal a trifle too hot and use the action of the sprue metal as a basis of judgment to temper down for the remaining molds.

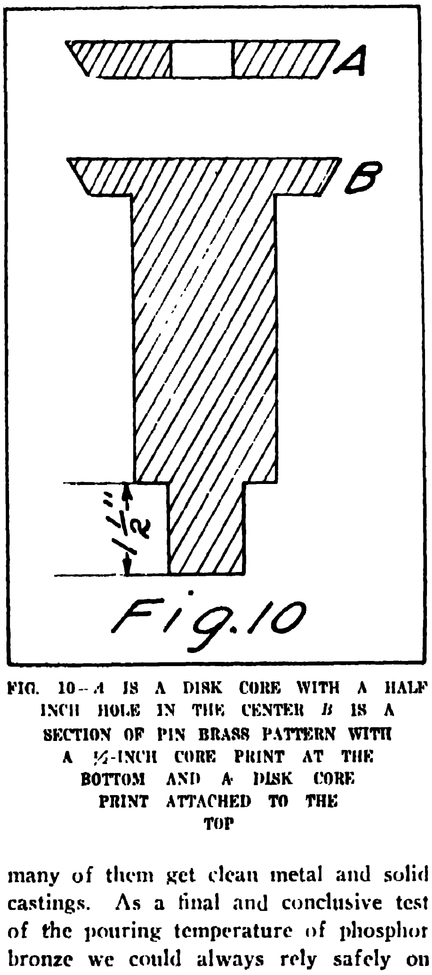


FIG. 10—A IS A DISK CORE WITH A HALF INCH HOLE IN THE CENTER B IS A SECTION OF PIN BRASS PATTERN WITH A ½-INCH CORE PRINT AT THE BOTTOM AND A DISK CORE PRINT ATTACHED TO THE TOP

Brazing flanges smooth all over are not easy to make even though the molds be perfect. Poured cold, they shrink and come out with a wavy surface. On first melting, hot metal develops much white powder (zinc oxide) which enters the mold in pouring and shows on the cope of the casting. By using yellow brass pipe or chips with copper, instead of zinc with copper, pleasing castings result. However, the brass melter is not always sure of the metals contained in yellow pipe or the proportions of zinc to copper. Pouring a second melting of virgin metals combined is a rather expensive solution. A cheaper plan is to combine copper 72, zinc 28 and cast in pigs. Then use this prepared alloy along with virgin copper in the ratio of two parts copper one part alloy. This gives copper 86, zinc 14 and results in sound castings, especially when used with gates from preceding heats.

Oxide in Iron an Undetermined Question

By H. E. Diller

Question—Does iron oxide enter gray iron melted in the cupola, and remain there becoming emulsified? Would oxide be more likely to be taken up by a mixture of pig iron with steel scrap? If the oxide is taken up by the metal how is it possible to hold it in the presence of so much carbon and silicon?

Answer—Oxygen does enter iron melted in the cupola if conditions are highly oxidizing. Whether this is taken up in the form of oxide and held in that form, or whether the gas is simply occluded in the metal has not been definitely proved. If the oxide is formed it no doubt does remain in the iron for some time as all chemical action requires time for its completion. Were the iron held at a high temperature for a sufficient length of time in a reducing or neutral atmosphere all oxygen probably would be removed from it, certainly none would continue to exist as the oxide. As it is, the air strikes the molten iron as it drops through the coke bed in the cupola, and if there is an excess of air, some of the iron as well as carbon, manganese and silicon are oxidized. The oxides which are not gases tend to go off in the slag. On the other hand if oxygen is occluded in the metal, it may be held there until the iron sets. Up to the present no method of generally acknowledged accuracy has been developed for determining the amount of oxygen in iron. It has been shown that steel or small particles of iron such as borings will tend to oxidize in the cupola.

Manufacturing Chilled Iron Car Wheels - IV

Different Types of Chillers Are Described and Methods of Annealing Fully Detailed

BY H. E. DILLER

BEFORE following the progress of the car wheel to the annealing pits, the chiller and its application in molding should be considered. The chiller's function is to draw the heat from the molten metal as rapidly as possible and as iron is a good conductor of heat, it is employed for the purpose. It is necessary to coat the surface of the chiller which comes into contact with the molten iron, the double function of the coating being to preserve the life of the chiller and to give a better surface on the tread and flange of the wheel. One method of coating employs a covering of shellac. This is applied before the men go home at night. The chiller may be used with no further treatment but some foundrymen use an additional coating of medium or light mineral oil before putting it in the mold. At other foundries no shellac is used but the chills are coated with a mixture of lard oil and some pigment such as iron oxide or coke dust. At one plant cylinder oil is substituted for the lard oil and this is thinned with kerosene, as is also the lard oil mixture in the winter months.

When hot metal enters the mold and strikes the chiller, the coating instantly is changed into a reducing gas and leaves a thin deposit of carbon on the mold. The gas causes a bubbling in the metal as it rises in the mold and the ebullition causes the iron to carry up with it any particles of sand which may have entered the mold. If this reaction were not present, dirt in the iron, when it rises to the top of the metal and is drawn to the side against the chiller would stick there because the metal would be cool and sluggish, and would not have life enough to carry the dirt up with it. The use of the coating prevents moisture forming on the chiller, thus reducing chill checks and producing a smoother tread.

The metal from which the chiller is made also has an influence upon its length of life. A chiller made from soft, open-grained metal does not last as long as one made from a closed-grained iron. For this reason many foundries cast them from the same metal as that from which they make the wheels while others modify the mixture somewhat. A recommended procedure is to cast the chillers from the first tap of the cupola, which is inferior for car wheels. Common chillers made in this way will produce from 300 to 600 wheels.

After the chiller is cast it is carefully machined to diameter and precautions must be taken to see that it is a true circle. When it has been used for some time, the diameter is likely to be increased due to wear on the surface of the tread and

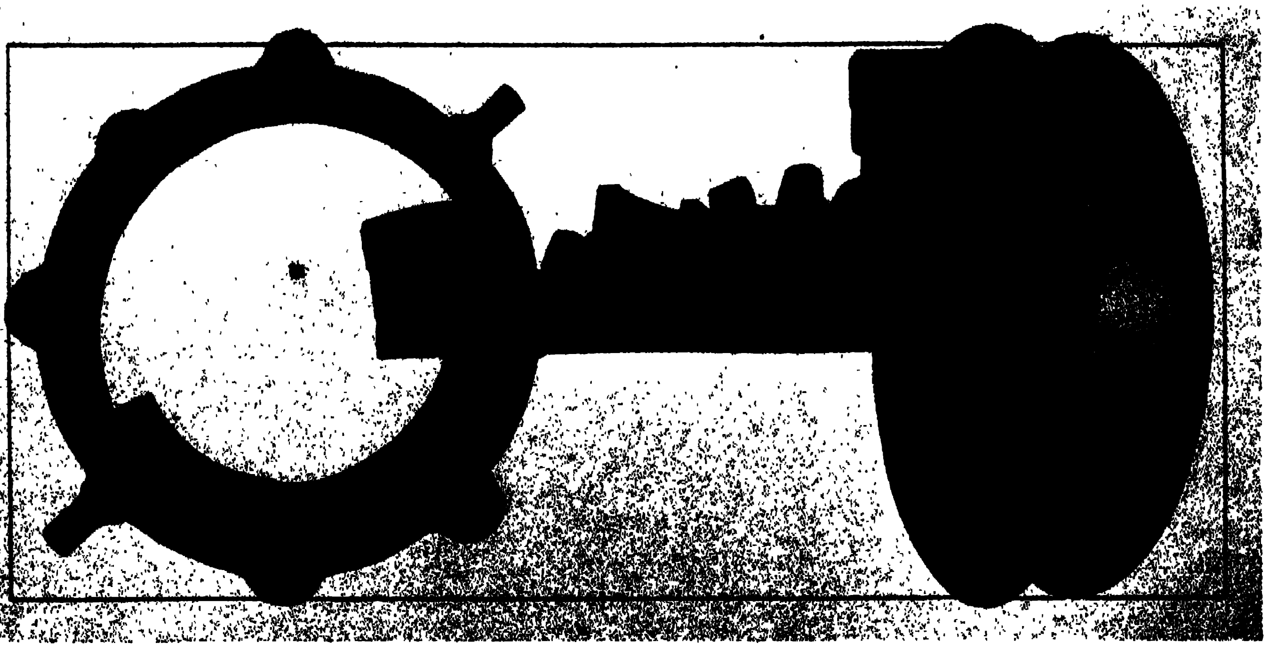
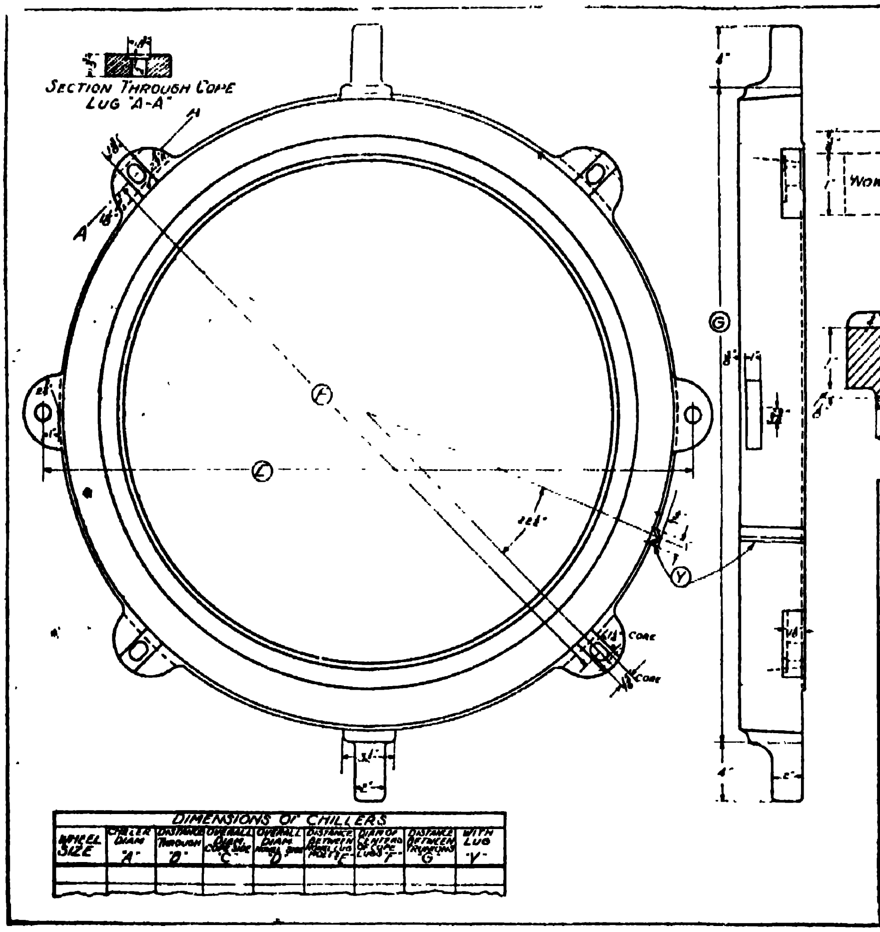


FIG. 31—DOUBLE FLANGE WHEELS ARE MADE WITH A SEGMENT CHILLER—THE SEGMENTS ARE PLACED AGAINST A SHOULDER IN A CAST-IRON CONTAINING RING—THEY FALL OUT READILY WHEN THE CHILLER IS RAISED AFTER CASTING THE WHEEL



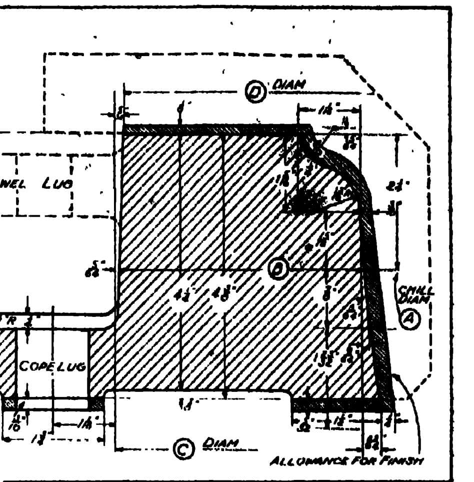


FIG. 32—THE COMMON CHILLER IS CAST IN ONE PIECE WITH LUGS AND TRUNNIONS—DIMENSIONS ARE GIVEN FOR THE 33-INCH WHEEL

flange. Therefore, the foundry occasionally must measure the chillers to find whether they are correct in diameter. A gage similar to the one shown in Fig. 35 enables a quick check to be secured. The gage consists of a board with two sheet-steel plates screwed on the ends. These plates are filed exact to the contour of the flange and tread of a wheel. The templet is slipped inside the circumference to gage the chiller. If the gage will not go inside the chiller, the latter is too small and must be further machined. When the gage enters the inner circumference of the chiller, one end of the templet is held stationary against the side and the other end is moved horizontally. If the gage will move more than 1 inch past the center; or, to express it differently, if it will cut an arc the chord of which is more than 2 inches, the chiller is rejected as being too large.

The common chiller is a solid ring with lugs and trunnions. One of these is shown in Fig. 32. The size of the cross section is governed by the amount of metal required to carry away the heat from the wheel, and is

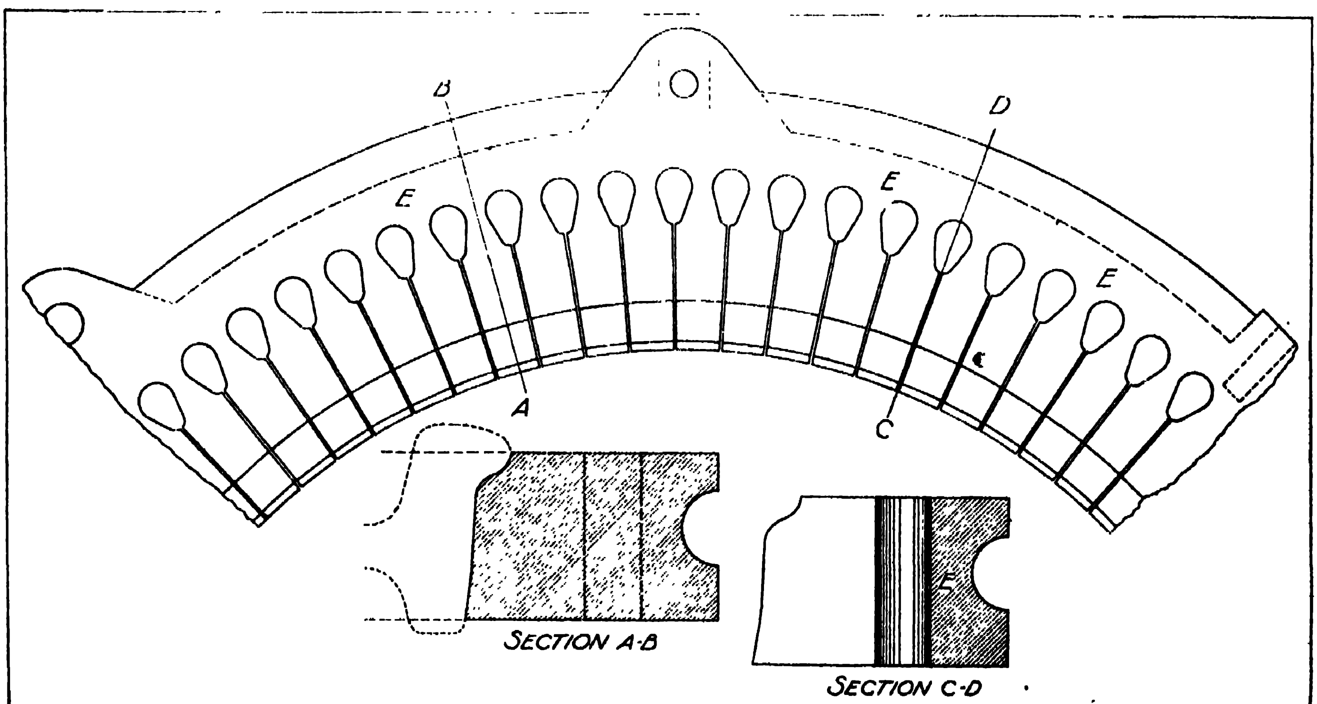


FIG. 33—CONTRACTING CHILLERS HAVE THE INNER CIRCLE MADE OF SEGMENTS WHICH CAN LENGTHEN UNHINDERED BY LATERAL PRESSURE—LARGE HOLES IN THIS CHILLER ARE CAST WITH SAND CORES—THE SLITS ARE FORMED BY SHEETS OF ASBESTOS, SHELLACED AND FIT INTO THE CORES

kept as light as possible on account of the difficulty in handling. The effect of heat on this chiller is the same as on a steel tire. The action of heat is utilized to expand a steel tire for shrinking it on a wheel center. However, with the chiller the expansion by heat is a disadvantage. As soon as the molten iron touches the chiller, the inside layer tends to expand while the outer layer is not immediately affected. This produces internal strains in the chiller and tends to shorten its life. The strains also have a tendency to warp the chiller and cause it to become out of round. The heat continues to cause the chiller to expand, while the metal of the wheel from which heat is being extracted begins to contract. These two reactions carry the wheel surface and the chiller in opposite directions and their contact soon is broken. Of course, after the chiller is no longer in contact with the wheel its further chilling effect is lost. Much thought and experimentation have been devoted to endeavoring to overcome these defects of the common one-piece chiller.

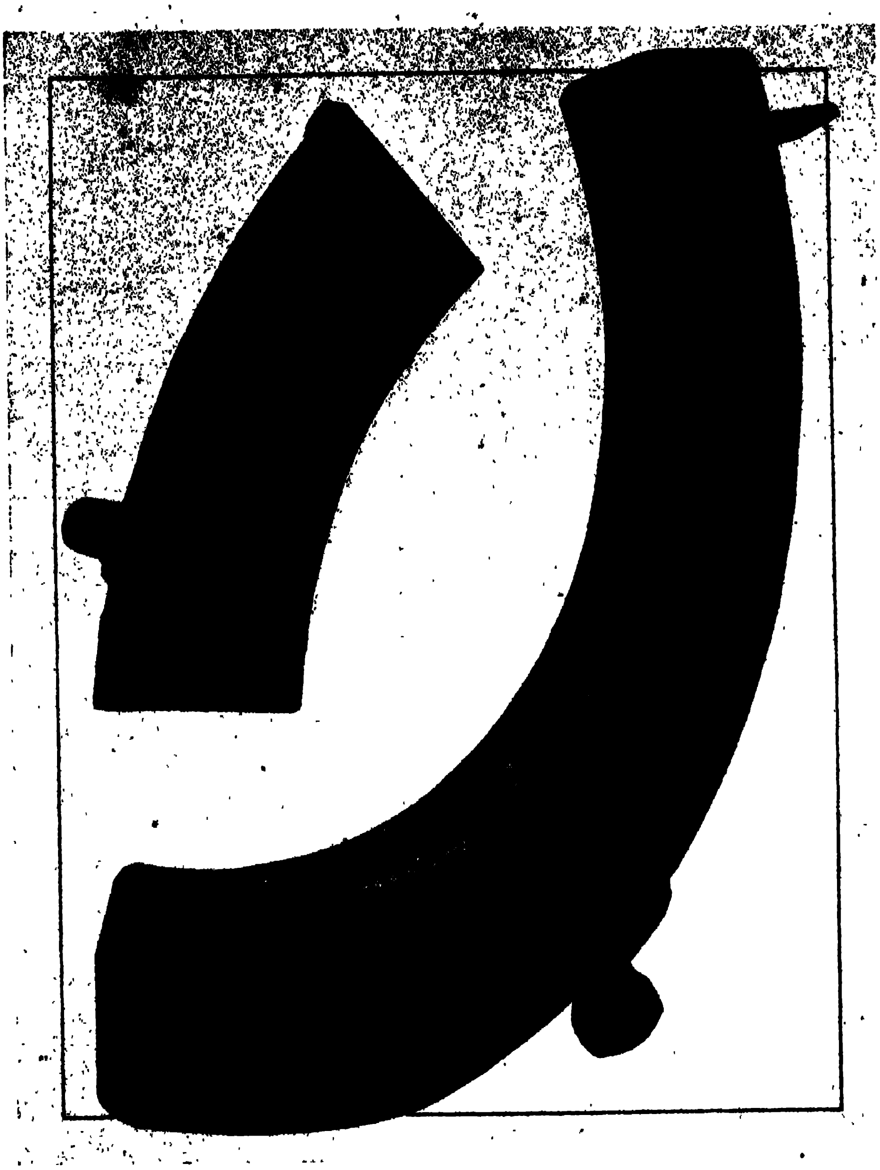


FIG. 34—SLOTS ARE MADE IN THE ASBESTOS-CUT CHILLER TO THE LEFT WITH THIN PLATES OF SHELLACED ASBESTOS—THE SEGMENTS IN THE CHILLER TO THE RIGHT ARE LOOSE PIECES CAST INTO THE CONTAINING RING

A split chiller consisting of two semicircles was tried. It had the disadvantage of making wheels which were not circular. The portion of the wheel in the center of the chiller, half way between the splits, was larger than the portion at the ends of the sections. This probably was caused by contraction of the metal causing the ends to bend inward and follow the contracting wheel.

Several patented contracting chillers have been brought out based on the principle of a broken inner ring. In some cases the chiller is in a single casting while in others it is made up of an outside solid ring in which segments are fitted to make up the inner circle which comes in contact with the casting. The theory of these chillers holds that the segments, as illustrated in Figs. 32 and 34, are free to expand when the hot metal strikes them, while the outer solid ring acquires heat much less rapidly. The heat causes the segments to lengthen and follow the casting which shrinks as soon as it sets. The expansion, or lengthening of the segments, continues until the ends of the segments come together forming a solid ring. Then the action becomes the same as though the chiller were a solid circle; the circumferential expansion of the segments expands the ring and causes it to take the opposite direction from the shrinking wheel. However, the segmental chiller follows the contracting wheel for some time while the common, one-piece, solid chiller tends to part from the wheel as soon as it is cast. The effect of contraction in the wheel may be realized when it is pointed out that the chiller for a 33-inch wheel is made with a 33½ inch inside diameter.

Fig. 33 gives the details of a contracting chiller which is cast in one piece. The holes behind the slots are cast in, being formed by sand cores. The slots are made by thin sheets of asbestos paper which are shellaced and then inserted in the cores that produce the slots. The asbestos sheets are 0.028 inches thick when shellaced and form a slot 0.025 inches wide. A section of one of these chillers is shown at the left in Fig. 34. This chiller is similar to the one known as the barr chiller. The main difference in the two chillers is that the section which is

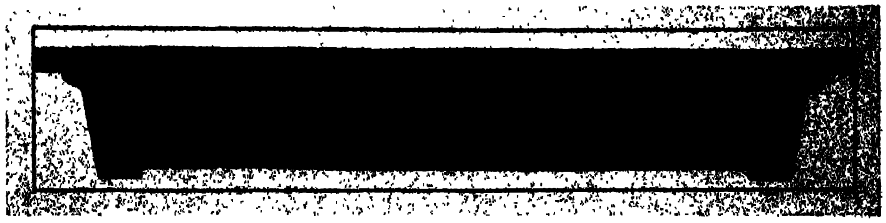


FIG. 35—CHILLERS ARE DISCARDED WHEN THEY BECOME TOO LARGE—A GAGE INDICATES TO THE FOUNDRYMAN WHEN THIS POINT IS REACHED

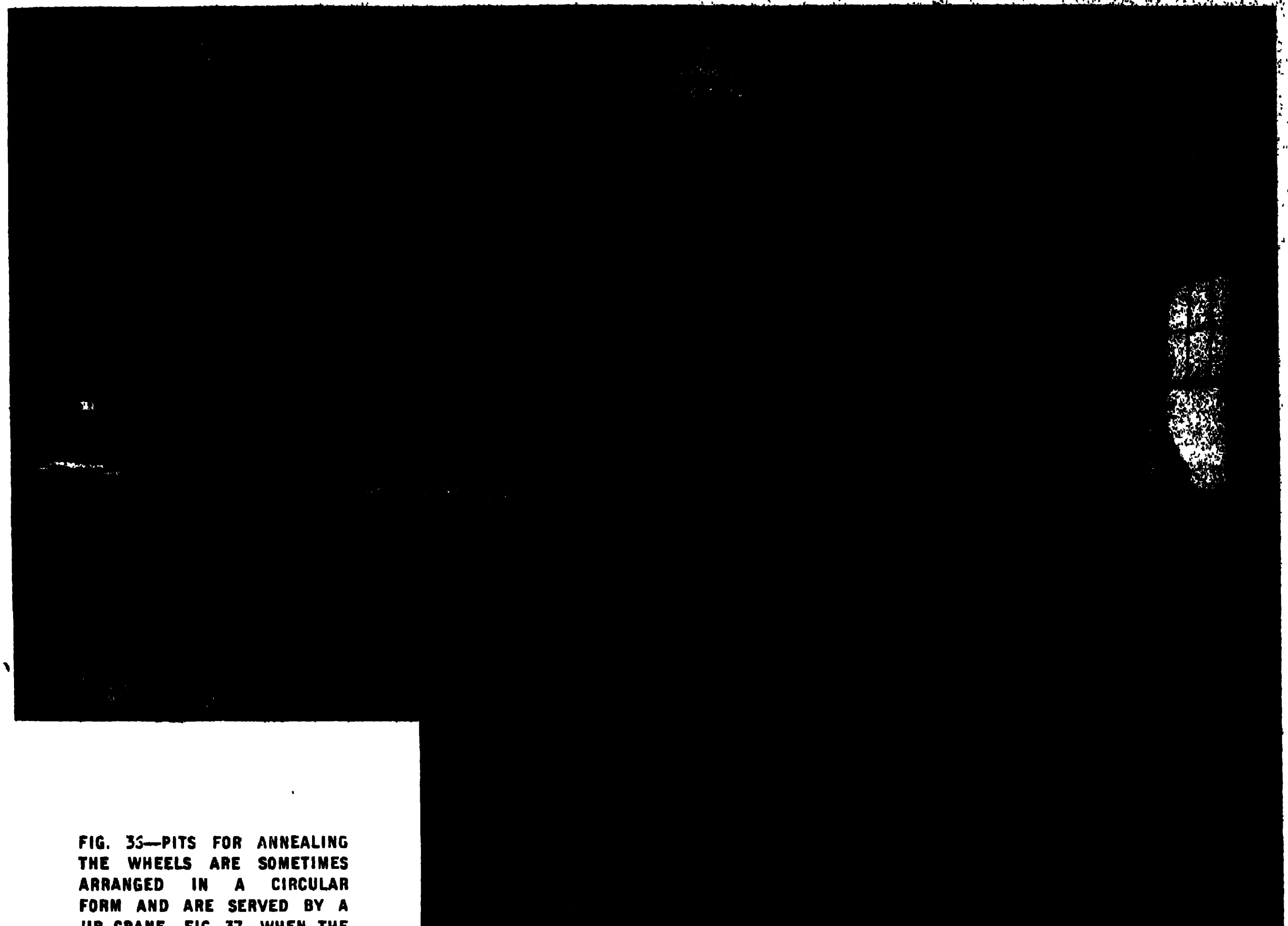
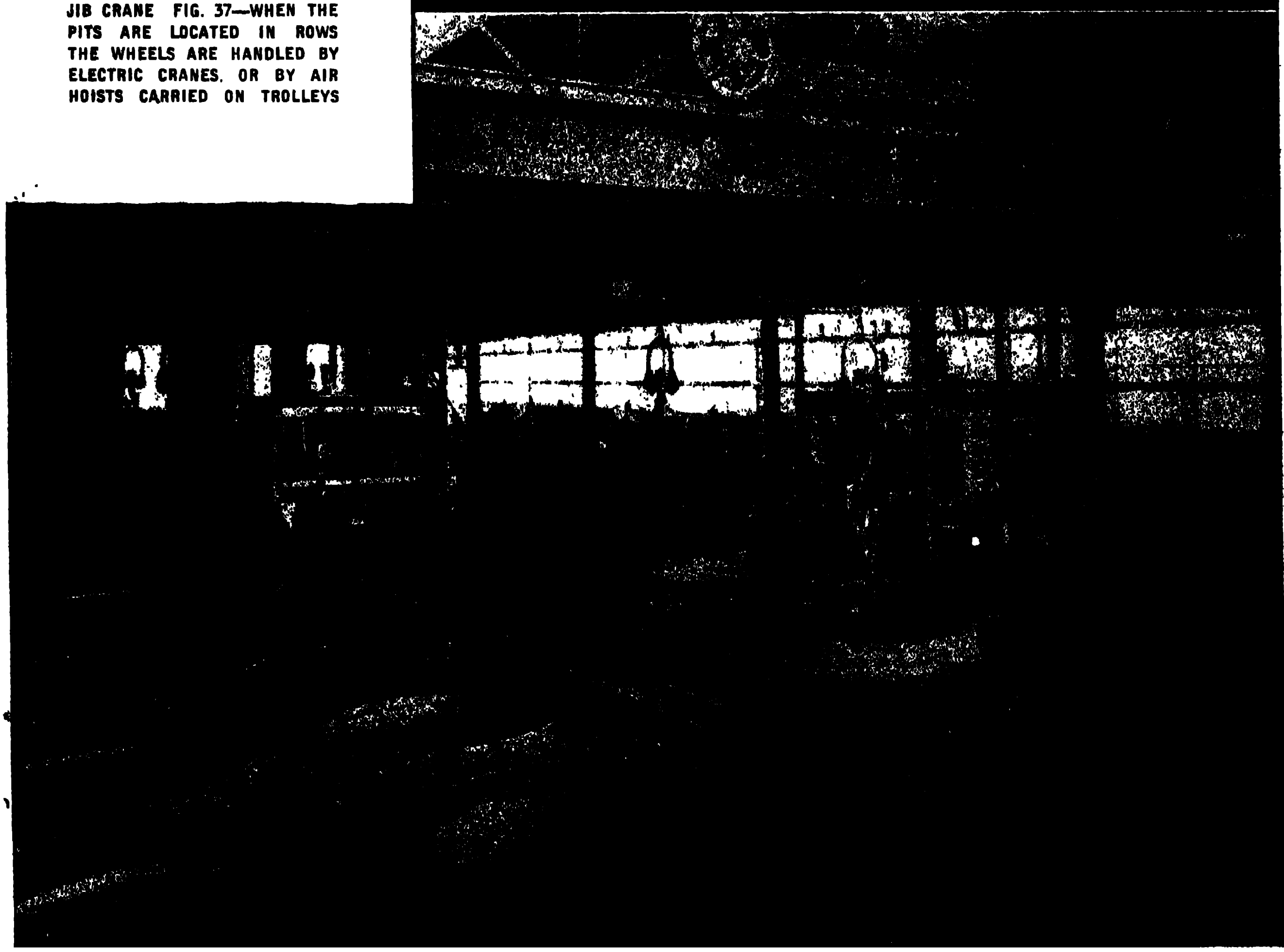


FIG. 36—PITS FOR ANNEALING THE WHEELS ARE SOMETIMES ARRANGED IN A CIRCULAR FORM AND ARE SERVED BY A JIB CRANE FIG. 37—WHEN THE PITS ARE LOCATED IN ROWS THE WHEELS ARE HANDLED BY ELECTRIC CRANES, OR BY AIR HOISTS CARRIED ON TROLLEYS



grooved by the asbestos is solid in the barr chiller and must be cut by sawing. As a chiller is too hard to saw readily when made from the regular car-wheel iron, a foundry making car wheels can not cast the barr chiller and saw it unless a special mixture is used in the cupola. This has induced some foundries to change from the barr to the asbestos-cut type.

Another chiller, which is designed with an inner ring made of segments, is shown to the right in Fig. 34. This is a patented device in which the segments are made separately and cast into a solid back which binds them together.

Due to the solid construction of the common chiller, great internal strains are set up in it when a wheel is cast, and so its life is shortened on account of heat cracks, warping and breaking. The construction of the contracting chiller, allowing a freer movement of the inner circle, makes it less subject to warpage and tends to preserve its true circular form. The contracting chiller has a much longer life than the common chiller.

However, the greatest objection to the use of the contracting chiller is the necessity for applying a filler to close the intertices between the segments on the side against which the wheel is cast. Varnish is used for this purpose and when it is not properly applied to the entire chilling surface, fins will form on the tread of the wheel cast against it. Such wheels then must be ground to remove the fins.

The filler, or varnish used on the chiller formerly was based on shellac, but since the price of shellac has advanced, some foundries have substituted rosin. The gum is cut with alcohol and a filler, such as ordinary coke dust, is added to thicken it. This usually is applied in the afternoon while the chillers are still warm from their day's use. The liquid is rubbed well into the slots and all surplus varnish is wiped from the chiller. Before making the mold the following day, the face of the chiller is oiled with a mixture of machine oil and kerosene.

Results of Experiments

A firm which has experimented extensively with different chillers found that the contracting chiller produces a wheel in which the chill was uniform around the entire circumference, while with the use of the common chiller, a variation of as much as ¼-inch in the depth of the chill was found at different points on the same wheel. This company also found that wheels cast from the contracting

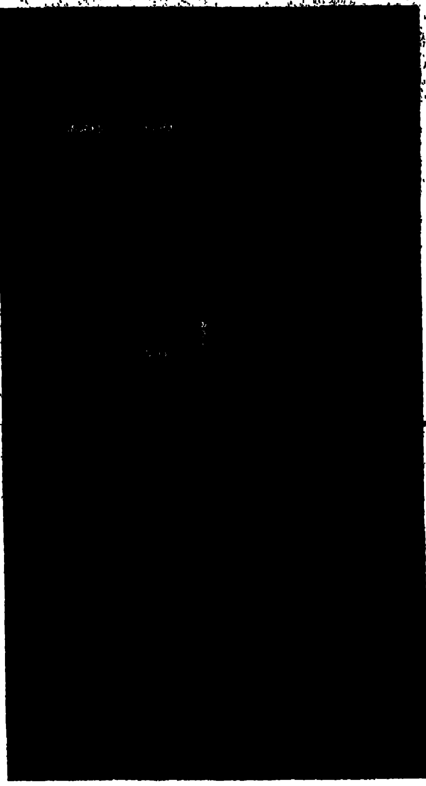


FIG. 38—WHEELS ARE CARRIED BETWEEN TWO BANKS OF PITS AND RAISED BY AIR HOISTS

chiller were truer circles than wheels cast from the common chiller, especially after both types had been used some time. The defects from chill cracks were shown to be less with the contracting chiller. The action of the segmental style in following the wheel as it contracted was found to give denser metal in the chilled portion of the tread and flange of the wheel, but the gray-iron towards the center of the wheel was not noticeably affected. This also may be assumed from the fact that when wheels are cast from these different chillers, the wheel from the contracting chiller will be somewhat smaller than the one from the common type of the same inside diameter.

The experiments from which the foregoing conclusions were reached were made under identical conditions for the different types of chillers. While one floor was poured into one style chiller another floor was being poured into another type of chiller and the wheels from the two floors were compared by drop test, tape measurement and inspection of the broken wheel, as well as by service tests.

A Different Type Chiller

Wheels which have a double flange require a type of chiller that differs from the single-flanged wheel as, obviously, it would be impossible to remove a circular chiller from the wheel when cast. One of these wheels with the chiller used is illustrated in Fig. 31. The chiller is made of a solid periphery into which segments are fitted. These segments lay against a ridge in one side of the containing band and are free at the other side. When the wheel is cast and lifted from the mold the segments are free to fall out and release the chiller from the casting.

It has been mentioned, that as soon as the wheels are shaken out they are carried from the molding floors to the annealing department on the hotwheel cars. As has been stated, those usually run on narrow

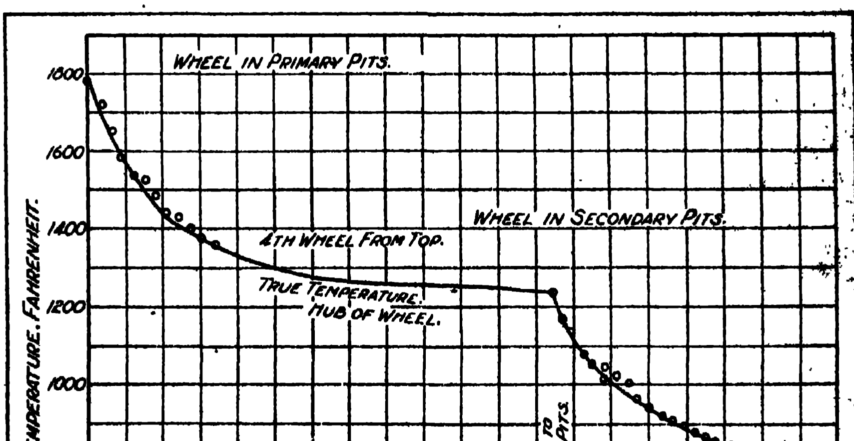


FIG. 39—THE CURVE SHOWS THE DROP OF TEMPERATURE IN THE ANNEALING PIT AND THE EFFECT ON THE TEMPERATURE OF TRANSFERRING THE WHEELS TO A SECONDARY PIT AFTER THE FIRST DAY

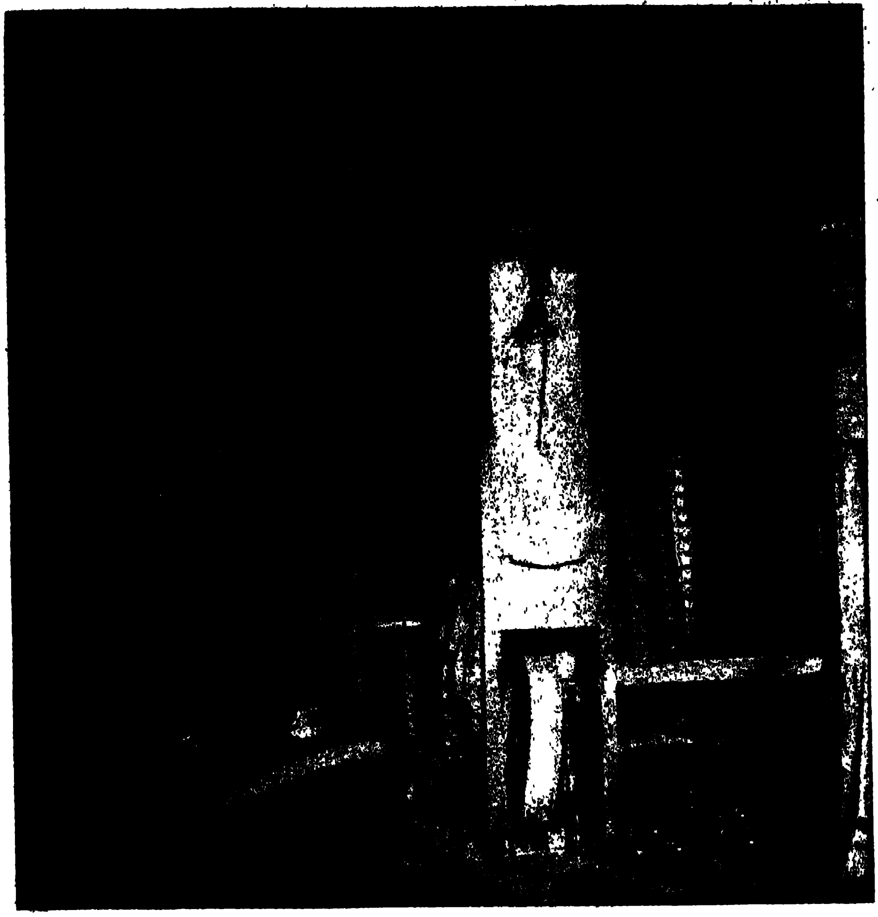


FIG. 40—A WHEEL IS PLACED ON GROOVED ROLLERS WHICH REVOLVE IT WHILE IT IS BEING SANDBLASTED

section of the annealing department, through which the tracks for the hot wheel cars extend is illustrated in Fig. 38. Steel beams extend across the annealing room at right angles to the hot-wheel track and are so spaced that a beam is above each line of pits. The beams support trolleys which carry air hoists to lift the wheels from the cars. These are spaced on the same centers as the cars in the train, so when one of them is stopped under a hoist all cars on the train are similarly located. To the right of this illustration may be seen the rods used for scraping the sand from the hub of the wheel.

Another system for pitting the wheels is illustrated in Fig. 37. By this method an operator in the cage of a traveling crane controls hooks which pick up and carry two wheels, one on each side of the crane. In this system a crane is required for each two lines of pits, but these lines may be made longer than in the other system without appreciable disadvantage, for the cranes travel considerably faster than a workman pushing the air hoist in the system first described.

Like the molding floor, the annealing department is sometimes laid out on the circular system. In such

gage tracks which are laid along one side of the foundry at right angles to the direction of the molding floors. The hot-wheel cars are connected to each other in a manner similar to the hotmetal trains and all move together. This speeds up the operations connected with loading the wheels. The train is operated from a cage about half way from the end of the foundry to the annealing section. The operator is able to judge the correct time to move the cars, which start off slowly, to give the workmen an opportunity to release the wheels and get clear of the train.

Commonly the floor of the annealing department is raised above the level of the molding floor. This saves the expense of excavation. It also gives the workmen a better opportunity to take hold of the wheels, especially when air hoists are used. The hot-wheel train usually runs along the side of the annealing department on the foundry floor level. Sometimes the track extends into the annealing department cutting it into two sections. These two systems have the common merit of providing a long line of track where the cars may be placed so as to carry the wheels to the different pits.

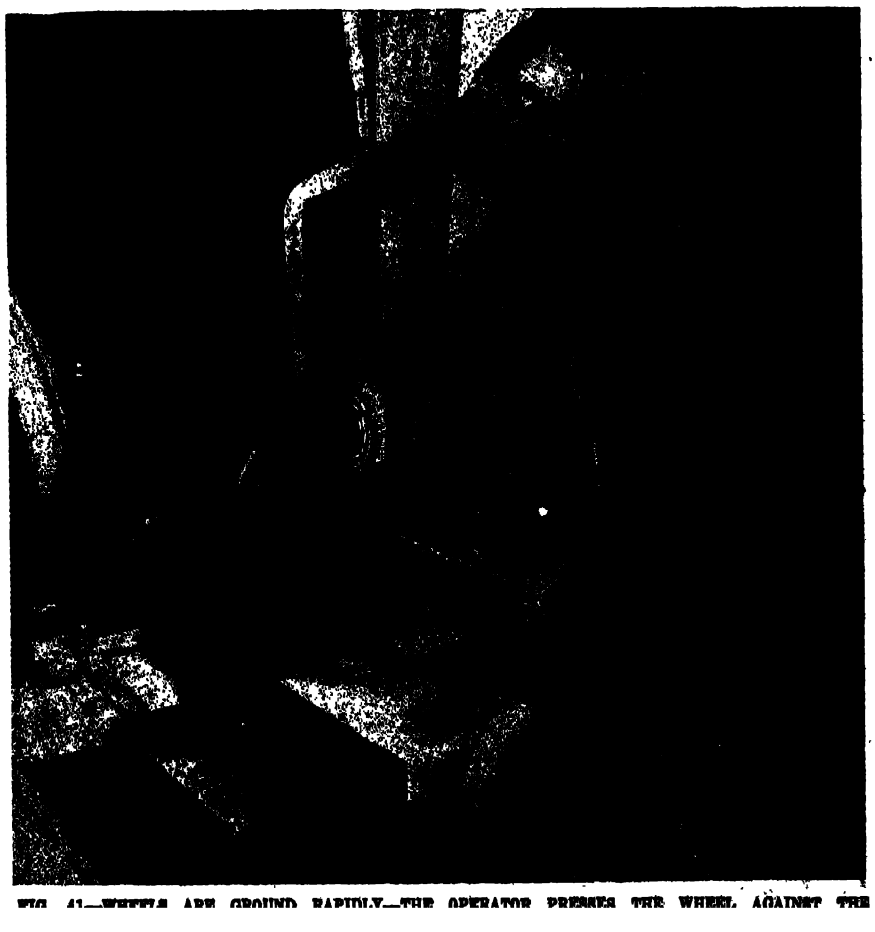


FIG. 41—WHEELS ARE GROUND RAPIDLY—THE OPERATOR PRESSES THE WHEEL AGAINST THE

cases the wheels are pitted with jib cranes which swing across the pits. Fig. 36 illustrates an annealing department of this type. This foundry also utilizes the circular system in the molding department, as may be noted by the arrangement of the flasks in the foreground. Two styles of hooks for holding the wheels may be noted. The wheels are picked from the molds by hooks which take hold at the circumference, while they are placed in the pits with hooks that engage the hub. A hook of the former style may be seen holding a wheel at the right of the illustration. The second type hook hangs on the jib crane.

The annealing pits are steel tanks lined with firebrick washed with clay. They are set a few inches from each other and the intervening space is filled with brick in mortar or some other heat resisting and insulating material. The pits are heated before the wheels are put in them either by wood fires, or by gas or oil. After the pits become heated no more heat is used to maintain the temperature than is given off by the wheels which go into them, unless there is a shut down of part or all of the foundry.

The depth of the pit governs the number of wheels which it will hold. This number varies considerably in the different foundries. Some foundries have pits which do not hold more than 12 while the pits in other foundries will hold as many as 30 wheels. However, the diameter of the pits is practically the same in all foundries, being only slightly larger than the standard 33-inch wheel. The object is to provide as little spare space as possible and yet to allow ample clearance to permit the wheel to be placed in the pit without difficulty. Cast-iron caps are used. Frequently these are covered over with a layer of sand to help maintain the heat in the pit. Again, a cover is placed over the wheels and another cover is placed on the pit.

By filling scattered pits each day the temperature is kept more constant than if an entire section of pits was filled at the same time and then emptied on the same day. A common method for scheduling the work as it is placed in the pit and removed includes a diagram of the layout of the pit floor on a board. The locations of each pit is marked with a black circle and the date the pit is to be pulled is indicated on the circle with chalk.

Wheels are held in the pit four and, in some cases, five days. They then are taken out and allowed to stand on the cooling floor for one day. This is advisable because the wheels as taken from the pits are too hot to touch with the hands. The wheel at the top of the pit on removal will have a temperature around 800 degrees Fahr. and the wheel from the bottom averages [illegible] degrees hotter than this. The difference in degree of cooling of the wheels in the pit is watched closely by the annealer and in some foundries a record is kept of the wheels in the top of the pit. If the annealing is too irregular, the effect may be detected by the color of the oxide on the wheel. The best practice causes a red oxide to form on the wheels. However, when the upper wheels cool too quickly they will develop a blue scale.

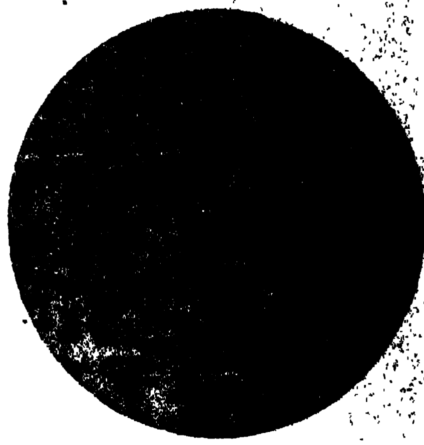
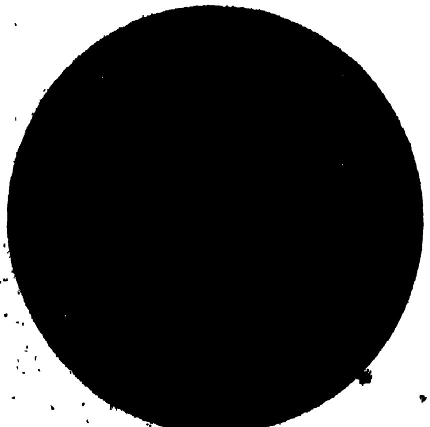


FIG. 44—MICROSTRUCTURE OF THE CHILLED SECTION OF A WHEEL BEFORE ANNEALING—MAGNIFIED 100 DIAMETERS FIG. 45—THE ANNEAL BREAKS DOWN THE COARSE CRYSTALLINE STRUCTURE INTO FINER GRAINS



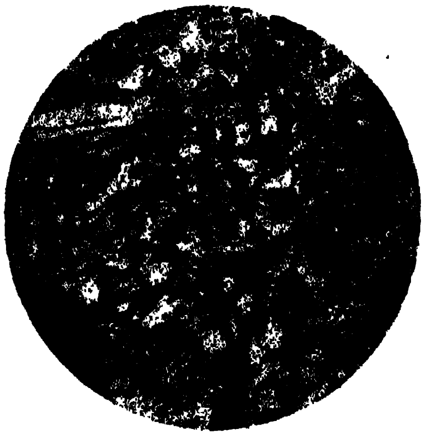


FIG. 42—MICROSTRUCTURE OF THE GRAY-IRON PLATE OF A WHEEL BEFORE ANNEALING—MAGNIFIED 100 DIAMETERS FIG. 43—SAME AS FIG. 42, AFTER BEING ANNEALED—NOTE THE GREATER PERCENTAGE OF GRAPHITE

Annealing relieves the shrinkage strains and this formerly was thought to be the only function of this treatment. In recent years a large amount of investigation has been carried on to study the effect of annealing on the structure of the iron. It has been determined that the anneal enlarges the ferrite crystals in the gray-iron portions by precipitating part of the combined carbon as free or temper carbon. This softens the gray portion of the casting, but the same effect is scarcely noticed in the white, chilled iron which remains almost as hard after annealing as before. The results as indicated by the study of the microscopic structure have been confirmed by brinell hardness tests. The tread of the wheel shows a brinell hardness number ranging from 450 to 500, and the gray-iron section will have a hardness number ranging from 120 to 210, depending largely upon the anneal. Before annealing, the gray iron may have a brinell number as high as 300 while the number of the white iron seldom is lowered more than 50 points by the anneal. From this it may be seen that the gray iron is more sensitive to variation in the anneal than is the white iron.

The microstructure of the car

wheel before and after annealing is shown in Figs. 42 to 45, which are micrographs magnified 100 diameters. Figs. 42 and 43 illustrate the gray-iron section of the plate of a normal wheel before and after annealing, respectively. It may be noted how the cementite shown in the white blotches in Fig. 42 has broken down into pearlite and graphite as illustrated in Fig. 43. Similarly, the effect of annealing the chilled-iron is shown in Figs. 44 and 45. The coarsely crystaline structure of the unannealed chill, Fig. 44, is refined to a finer structure as may be noted in Fig. 45.

The length of time of the anneal was determined by experience years ago when practically nothing was known of the metallurgical side of iron founding. This annealing period has been little changed, although something has been done in the way of designing pits to carry the surplus heat from the bottom to the top and so to equalize the temperature of the different parts of the pit. However, tests have been started recently to determine whether it would be possible to shorten the length of time of the anneal. One method suggested is to transfer the wheels to a secondary pit after they have soaked in the first pit for about one day. A diagram of a temperature curve taken at the hub of the fourth wheel from the top of a pit is shown in Fig. 39. This indicates that the wheel went into the pit at slightly less than 1800 degrees Fahr. which is the average temperature at which wheels are pitted. The wheel then cooled with comparative rapidity to the region of 1300 degrees when the cooling gradually became slower. For several hours the temperature remained almost stationary around 1250 degrees. This same slow rate of cooling would have continued throughout the remainder of the anneal if the wheels had been allowed to stay in the pit, and after three more days the wheel would still have been hotter than 800 degrees. This would have shown a drop in three days about equal to the drop in the first third of a day. However, after the wheels had soaked 1250 minutes, or slightly more than 20 hours, and were cooled to a temperature below the recalescence point, the wheels were transferred to a specially designed secondary pit which allowed them to cool more quickly. More detailed data is being acquired on this method before it will be pronounced a successful procedure.

From the pits the wheels are taken to the cleaning room. This department is not elaborate in any car wheel foundry. The treads of the wheels usually need little attention and it is comparatively easy to clean the sides of the wheels. Both hand cleaning and sandblasting are used to remove sand from the sides of the wheels. The sandblast machines used all are of similar design. The procedure may best be described by referring to Fig. 40 which shows a wheel in the sandblast. A wheel is rolled into the compartment and the door is closed. The operator then turns on the blast which strikes the wheel as it is revolved by the two grooved rollers in the floor, on which it rests. These rollers are moving continually and attention need not be given to see whether the wheel is revolving. After the blast has been operating for approximately 10 seconds, the operator shuts it off and raises the door. A workman pulls out the wheel and places it ready for the weighing operation, while another rolls a second wheel into the sandblast and closes the door. The complete cycle of operations is over in less than a minute.

As has been noted in describing the contracting chiller, the use of this style chiller necessitates grinding the tread and flange to remove fins. Even with the solid chiller, a grinding machine frequently is required to take off little shifts and fins on the flange. One of these machines in operation is illustrated in Fig. 41.

The abrasive wheel, shown in the background turns continually. In its normal position the car wheel does not touch this revolving wheel. Contact is made by the operator who moves the wheel forward by pressing the lever on which his foot rests. The wheel is shifted sideways by the lever in the man's left hand. With his right hand he slowly revolves the wheel.

The complete operations in the manufacture of the wheel have been outlined, but the wheels are not ready for shipment to the customer for they must first stand a rigid inspection by a representative of the railroad to whom they are to be shipped. These tests will be described in a future article of this series.

British Foundries Feel Automotive Drain

The British molders' strike of last autumn has had a singular sequel in the Staffordshire district, which is a great center for the manufacture of rolls and heavy mill machinery. In the heart of the iron works district at Tipton, some of the largest automobile manufacturing companies have their headquarters and they are largely under the management of managers trained in America. These concerns are aiming at the largest possible mass production and, being short of molders, they have not hesitated to offer the men wages largely in excess of those which formed the basis of the recent settlement. The molders at the roll casting works are highly skilled men able to earn about \$19.70 a week, but under the liberal terms offered by the motor builders they are now able to earn as much as \$35.46 a week, and they have, accordingly changed their employment. The roll founders are not disposed at present to outbid the motor builders and as they have lost a number of their men, the production of heavy rolls has been reduced.

Little Magnesite Imported Last Year

The production of magnesite in United States in 1919 was about 30 per cent less than in 1918, but nevertheless was greater than any year prior to 1917. The output of crude magnesite was reported by the geological survey to have been 162,000 tons in 1919. It is thought that the large production should be satisfactory and encouraging to domestic producers, for even as late as June, 1919, it was expected that receipts of foreign magnesite would practically terminate the domestic industry. The imports were not received as expected and the demand for magnesite for refractories and plastic wares had to be supplied from domestic sources.

Toledo Brass Foundry Nears Completion

The Nonferro Foundry & Pattern Co., 1361 West Bancroft street, Toledo, O., which recently was incorporated, has a plant which it is equipping with machinery and tools for a complete foundry and pattern shop. The company expects to be in full operation soon, and will manufacture brass, bronze and aluminum castings; wood and metal patterns. Officers of the company are: President and general manager, F. G. Simon; vice president, R. Eppich; treasurer, H. J. Badhorn; secretary, Joseph Huther, and assistant secretary, A. R. Rellinger. P. A. Gaynor, former manager of service and sales for the Bryan Pattern & Machine Co., Bryan, O., will hold a similar position with the company.

The Independent Pneumatic Tool Co., Chicago, has removed its Detroit office from the David Whitney building to the Garfield building.

Heat Treatment Vital in Welding

The Size, Shape, Weight and Material of Which the Casting Is Composed Are Factors in Determining How High the Casting Should Be Preheated

BY GEORGE B. MALONE

THE knowledge and skill required to weld castings in any kind of metal is one of the most important accomplishments a foundryman can possess today. In many cases it is possible to salvage an expensive casting; a practice and process unheard of a few years ago. During the war period, welding was practiced more extensively than ever before on account of the abnormal demand for all kinds of castings. Millions of pounds of castings were salvaged by welding, and accepted by the government inspectors as being perfect in every particular. The writer repaired over 2,000,000 pieces in one of the large industrial plants. The aggregate saving of the company from these operations amounted to $13,000 a week. Many foundrymen have yet to learn that a large proportion of the castings usually consigned to the scrap pile can be made commercially perfect by the welding process.

A large company with which the writer is familiar, which manufactures pumps, would not permit any of its castings to be welded until a few years ago. If a pump cylinder was slightly porous it was brazed. If the brazing operator was lucky enough to save the cylinder it would be camouflaged by painting, etc., and forwarded to the customer While the practice is common, it is the writer's opinion that brazing should not be employed except for making minor repairs to castings. In the first place, a microscopic examination will reveal hair-line cracks in brazed sections, and, in the second place, all the time and labor spent in preparing the casting for brazing will be lost if the job does not turn out satisfactorily.

Importance of Preheating

The proper way to repair a casting, particularly a cylinder, is to preheat it and then weld it. The temperature to which any casting should be preheated depends upon its shape, size, the purpose of the preheating and the metal of which the piece is made. To illustrate the difference in preheating temperatures, consider first a heavy piece of cast iron the shape of which should not produce any contraction strains while cooling, and then consider a light complicated casting like an automobile cylinder In the first case it is evident that the purpose of preheating is to save gas and labor, and that the preheating temperature can be raised to a cherry red because there will be no danger of distortion or cracking. In the second case the conditions are entirely different, the preheating must not be carried to so high a degree as to warp the cylinder but must be carried high enough to permit the casting to contract without cracking when cooling.

Welding Large Steel Castings

In this case, the amount of gas saved by preheating is negligible In the first case the temperature may vary from 1200 to 1500 degrees Fahr., while in the second case it should not exceed 800 degrees Fahr. In other cases where the style or type of cylinder is quite simple a lower temperature is sufficient. To attain the highest degree of efficiency, the degree of heat should be measured by some suitable recording instrument. Great care must be exercised in welding hollow castings such as radiator castings, water backs, etc. This type of casting must invariably be preheated. The only special instructions that can be given in these cases are that the welder use all precautions.

Large steel castings may be welded without preheating, where wear is not a factor. It is preferable, however, in all cases, particularly where iron or steel castings lie in a damp place, or where they are subjected to intense cold, that they be brought to the welding temperature slowly. The reason for this is that as soon as the welding torch is applied to a cold casting the chances for crystallization are good and not only will a poor weld result but in a great many cases the casting will be rendered unfit for use.

The salvage of small castings by the welding process is something that should receive more consideration from the foundrymen that it does at the present time. All foundries figure a certain percentage of lost castings. This loss can be reduced to a minimum and large savings made financially if the foundrymen will install welding equipment. The foundryman who has not yet installed a welding outfit is as far behind the times, in the writer's opinion, as the printer who is using an old-fashioned hand press.

Great care must be exercised in repairing brass and bronze castings by the welding process. The following incident, which took place in a plant making pistols for trench warfare illustrates this point. The pistol grips were made of bronze. The maker was at his wit's end to know how to reclaim castings which contained sand holes when received from the foundry. The writer was consulted and upon visiting the plant found that the tool department, which had charge of all welding operations, was using Tobin bronze on the job. When the grips were polished they showed a bright yellow streak where the weld was made. The government inspector would not pass them and hundreds had been rejected. The difficulty was overcome by using a welding rod carrying a higher copper content than the metal in the casting. After personally welding ten grips they were polished and placed before the inspector who passed them.

When it is desired to weld a casting, a welding rod of the same analysis as the casting should be used. Little difficulty will then be experienced in salvaging castings. This is particularly true in the case of brass or bronze castings which may have to be polished. They will show a different color at the weld if this precaution is not observed.

Welding Monel Metal

Many foundrymen have experienced difficulty in welding monel metal castings. They are really not any harder to weld than the ordinary iron castings if the proper procedure is followed. The analysis of monel metal shows a large nickel content and a nickel casting cannot be welded without preheating. On account of the combination of copper with nickel

From a paper read at the Philadelphia convention of the American Foundrymen's association. The author, George B. Malone, is connected with the Bayonne Steel Casting Co., Bayonne, N. J.

in monel metal it is apparent that the casting must be brought to a rather high temperature, say 1600 degrees Fahr., before the weld is attempted. After the casting has been welded it should again be brought to approximately 1500 degrees Fahr., and placed in hydrated lime to prevent any air from getting to it.

In many cases the foundrymen will tell you that when the weld was made the casting looked sound but 10 minutes afterward it was cracked. The reason for this is that proper care was not taken with the casting after the weld was made. It should have been allowed to cool slowly under a covering of hydrated lime which is the best substance the writer is acquainted with and which he always uses for this purpose.

How and Why in Brass Founding

By Charles Vickers

Gas Fittings Stand High Pressure Test

Can you please inform us in regard to the formula for gas fittings? Can this alloy be made to retain a water pressure of 40 pounds per square inch, and can it be cast by the ordinary methods in use by manufacturers of plumbers' supplies?

Gas fittings are generally made of scrap metals because the price at which they are sold does not permit the use of new metals. Yellow brass chips and yellow brass ingot are suitable material for this class of brass castings. However, if a new mixture is desired, the following alloy will be suitable: Copper, 66 per cent; zinc, 30 per cent; lead, 2.50 per cent, and tin, 1.50 per cent.

Yellow brass of the above formula ought to withstand pressures of 40 pounds per square inch, provided it contains no aluminum as an impurity, and is cast free from zinc oxide. However, it cannot be expected to withstand 300 or 400 pounds per square inch pressure. A few castings might stand these pressures, but unless the alloy is handled very skillfully in melting, molding and pouring, the production loss will be high due to failure under hydraulic pressure.

The methods used by makers of plumbing goods are correct for any alloy of yellow brass. Pour the metal strongly at a lively temperature, always keeping the heads filled. Needle vent the tops of flanges, and draw parting vents from all angles of the castings to the sides of the flask.

Shrinkage Defects in Aluminum Castings

We have sent for your information an aluminum steering wheel spider, of which we have had a number of rejections on account of the blowholes which can be noted on the upper, polished surfaces. Any suggestions you may see fit to make regarding the cause of these defects, and what must be done to avoid the same, will be greatly appreciated.

An inspection of the casting shows that one of the arms is comparatively heavy, that it is bored out and the metal appears to be sound. The hub of the wheel is cored out and the walls are comparatively thin. The heavy spoke is probably the one on which the gate is placed, because if it was not fed by a rather large sprue or a riser, it would shrink visibly, and the castings would be rejected in the foundry. It is noteworthy that in the case of the sample sent, the spoke directly in line with the heavy spoke, fails to show any of the "blowholes" visible on the two spokes at right angles to the heavy member. All of these spokes are separated by the thin hub with the result that a riser or sprue on the heavy spoke would not be able to supply metal to feed the shrinkage of the other spokes. The spoke that would have the best chance to be fed is the one that forms a continuation of the heavy spoke; the one opposite, and in the case of this sample, that spoke is free from defects. This leads us to believe the difficulty is entirely one of shrinkage; aluminum shrinks differently to brass, the eutectic appears to collect in little pools, in certain places and when it drains away to supply shrinkage at some lower point, small globular cavities are left under the congealed skin which are revealed as blowholes when the skin is cut away. We are assuming that this casting was made with the face in the cope, that the hub core was set in the drag. If the molds can be rolled over after closing, so that they are cast face down, there will be no more trouble with these cavities on the finished side. If the core print is made long and tapering so the core will wedge itself in the print, it will hang. It would be necessary to use a deeper cope than at present and this would give more pressure on the castings, which is needed. Aluminum being one-third as heavy as brass requires two-thirds higher cope to get the proper pressures. It would be advisable to try the effect of a larger sprue carried 3 inches higher first, and if this is not satisfactory it will be necessary to connect risers to each of the spokes to insure their being properly fed, when the difficulty now experienced will be overcome.

Wants High-Strength Aluminum Bronze

We are making castings of aluminum bronze containing 10 per cent aluminum and obtain 56,000 pounds per square inch tensile strength, with 40 per cent elongation. We would like to learn if it is possible to produce an alloy having 80,000 pounds tensile with 52 per cent elongation, and if so how it is made. We would also like to know whether aluminum bronze resist the action of acids in pickling tanks to such an extent that it might be considered a good acid-resisting alloy.

There is no alloy of copper and aluminum known, that in castings will possess a tensile of 80,000 pounds per square inch with over 50 per cent elongation. The tensile strength of the bronze now being made can be increased by the addition of iron to the mixture, but the elongation will be diminished. The strongest alloy of aluminum bronze so far developed contains approximately 4 per cent iron, 10 per cent aluminum and the balance copper. Aluminum bronze has a good reputation as an acid-resisting metal for use in pickling tanks.

High Speed Bushing Heavy Duty Alloys

We desire to learn which is the best alloy to use for bushings to be used in connection with machinery running at high speed and under heavy load. We would like to know if a hard phosphor bronze or a highly leaded bronze is the

best. Our suggestion is a bronze of the following formula: Copper, 84 per cent; tin, 10 per cent; lead, 3 per cent; zinc, 3 per cent.

If the bushings are to be carefully fitted to the shaft that is to run in them, a hard bronze would be more suitable than a leaded bronze, provided also that it can be properly lubricated. Under such circumstances a heat-treated aluminum bronze carrying 10.50 per cent aluminum has given excellent service. If the bearing is poorly fitted, and as a consequence has to "conform" to the shaft, a leaded alloy should be used; a suitable one being Ex. B metal as follows: Copper, 76.80 per cent; tin, 8.00 per cent; lead, 15.00 per cent, and phosphorus 0.2 per cent. For a well fitted bearing the mixture suggested in the query would be a good one to use. Elephant bronze would also be suitable; the alloy follows: Copper, 85 per cent; phosphor copper, 0.50 per cent; tin, 10.50 per cent; zinc, 2.50 per cent, and lead, 1.50 per cent.

Too Close a Sand Causes Blow Holes

We are casting housings for automobile starters and are experiencing difficulty with blow holes. Will you kindly inform us if the use of a mixture of Sandusky sand with Newport sand would prevent this blowing. We use No. 12 aluminum.

If the blowing is due to the use of too fine a sand, an admixture of a more open grade will remedy the trouble. Sand used for molds for aluminum should be fine and yet open in texture so the gases can pass through the mold. If the gas is unable to pass through the sand, it will pass through the aluminum, and it will do this much more readily than in the case of the heavier metals.

If when the sand is dried water soaks into it quickly, it is free venting, but if the water rolls down the slope and runs away from the sand, the latter is too close and had better be discarded. If the sand is free venting and still causes blown castings, then it is either being worked too damp, or the molds are being rammed too hard. A combination of clayey sand, hard ramming and too much water will always cause trouble in molding operations.

Charging Britannia Metal

We are making castings of britannia metal of the following composition: Tin, 88.90 per cent; copper, 3.70 per cent, and antimony, 7.40 per cent. We melt in a plumbago crucible and would like to be advised as to the best manner of charging the various metals into the crucible. Also, what flux should be used?

The best way to make the alloy would be by the use of a hardener, which is first produced as follows: Melt 37 pounds of copper, in the crucible, or any part of 37 pounds according to the size of the crucible, but it must be remembered that the same divisor used for the copper must be applied to the antimony also. Suppose the crucible will hold 250 pounds of metal. Melt 37 pounds of copper and when thoroughly liquid commence adding 74 pounds of antimony. The latter must be added to the copper gradually, with intervals of waiting as necessary to permit the metal to regain its lost heat. When the antimony is all added, there will be 111 pounds of molten metal in the crucible. To this add an equal amount of tin, or 111 pounds, then pour the hardener into ingots by dipping it out with a ladle. The britannia is then conveniently made by simply melting together 77.80 pounds of tin, with 22.20 pounds of hardener. By this method, a better alloy will be produced. The various metals will be alloyed better, as they will be more intimately mixed. For a flux use tallow or tallow and rosin, scattered on the molten surface. This will reduce the dross to a powder which may be skimmed off without great loss of metal.

Recommends Types of Melting Furnaces

We occasionally make a little brass work and have tried to melt the same on a forge, using a crucible and scrap brass. We desire to know if we can improve upon this practice by rigging up a little cupola and melting the brass with coke in the same manner as we melt cast iron? Also, we sometimes make steel castings, but not in quantity to justify the expense of putting in an electric furnace. Can steel be melted satisfactorily in a crucible? We would turn out about 4 tons a month.

Melting brass on a forge is very unsatisfactory and should be abandoned. A regular brass melting furnace of a size suitable to care for the work should be installed. Whether it is fired with oil, gas or coke will depend upon which fuel is most convenient. It will not pay to attempt to build a brass furnace unless the details of construction are thoroughly understood, as it will cost more to build than to purchase one. While brass can be melted in a cupola, this method should never be adopted except under stress of circumstances, as in the case of an extremely large casting. It is not feasible to melt brass in contact with sulphur containing fuels, because it will cause holes to appear in the castings. Steel castings can be commercially produced from crucibles, and have been for many years, but the electric furnace is now preferred. An oil-fired furnace of the Noble type, much used in Milwaukee, would be suitable for melting the steel in crucibles. This furnace consists of a rectangular hole in the ground lined with firebrick and connected to a stack. It is covered with bungs of firebrick. The pan type of burner is generally used.

Aluminum Alloys for Pressure Work

We have experienced considerable difficulty in making aluminum castings to be used as floats in a machine used in making distilled water. The castings are 6 inches long and 3 inches in diameter, with walls 3/16-inch thick. They are cylindrical in form with one end closed, and a ½-inch hole through the center of the other, and they weigh 13 ounces. The difficulty we experience is due to leakage, as the castings are subjected to 4 pounds per square inch water pressure. We have used practically pure aluminum, also auto crank case scrap, but all the floats leaked, as the heavy water pressure appeared to force the liquid through the walls of the castings. It has been suggested that we add antimony to harden the aluminum and close the pores. Any suggestion would be appreciated.

Both pure aluminum and scrap aluminum are unsuited as material from which to make castings to withstand pressures. Pure aluminum, meaning by this term commercial aluminum, is too open in character to be used for this purpose and scrap aluminum is too uncertain in composition. For pressure castings it is necessary to use an alloy high in copper, as the copper hardens the aluminum and closes its pores. Antimony is not suitable for this purpose, for while it hardens copper, it does not act the same with aluminum, it is in fact an undesirable addition to the light metal. For pressure castings of aluminum an alloy of copper 12 per cent; aluminum 88 per cent finds considerable application. Owing to the high percentage of copper it is slightly heavier than the regular No. 12 alloy containing 8 per cent of copper, and as weight appears to be a factor with these castings, it would be well to try an alloy of copper, 2 per cent; magnesium, 2 per cent, and aluminum 96 per cent, which has proved successful as a pressure resisting aluminum alloy. It has the advantage of being of low specific gravity and would appear to be suitable.

Electrical Melting of Alloys—VI

Electric Furnaces of the Indirect-Arc Type Have Proved Successful for Melting Zinc Bearing Alloys When the Bath Is Agitated to Prevent Local Heating

BY H. W. GILLETT

LOCAL overheating of the charge immediately under the arc limits the economical use of direct-arc electric furnaces to alloys containing not much over 5 per cent zinc, as was shown in previous articles. Likewise a similar, though less intense, overheating occurs under the arc of an indirect-arc furnace. This limits the economical use of the indirect-arc furnace to alloys with not much over 15 per cent zinc.

Therefore, the types of electric furnace best suited to melting steel fail to solve the problem of melting yellow brass. The cause of this failure lies in the fact that to get good thermal efficiency heat must be supplied rapidly, so rapidly, in fact, that conduction through the metal will not carry it away fast enough to prevent local overheating near such a concentrated and high-temperature source of heat as the electric arc.

The trouble from local overheating could be overcome by adopting a different type of furnace to cut down the rate of heat input, or to supply a less concentrated heat. If it is decided to employ the arc furnace, the rate at which heat may be distributed through the charge must be increased without decreasing the rate of heat input. Several workers were developing brass furnaces of the non-arcing type and, in order that all types might be tried, the bureau of mines took up the study of the arc furnace.

Distributing the Heat

The logical way to distribute the heat through the charge is to stir the metal. This should overcome the surface overheating due to hotter, and hence lighter, metal staying on top of the melt. It is obviously easier to do this in an indirect-arc than in a direct-arc type furnace where the arc is nearer to the metal. Since complicated construction in the hot zone of an electric furnace means a furnace of low reliability, stirrers in the melt are useless. The logical method for the avoidance of local overheating seemed to be to stir by moving the whole furnace, since such stirring can be done by means located wholly outside the furnace.

Stassano's first indirect-arc furnaces (*) for melting steel were designed to give some agitation of the bath. The furnace had its upright axis at an angle with the vertical, so that by turning it around mechanically, a gyratory motion was set up. The arrangement of the furnace is shown in Fig. 1. Of the later Stassano installations some were made stationary and some movable.

The Weeks (**) furnace is another indirect-arc furnace so mounted as to be capable of motion. It was designed

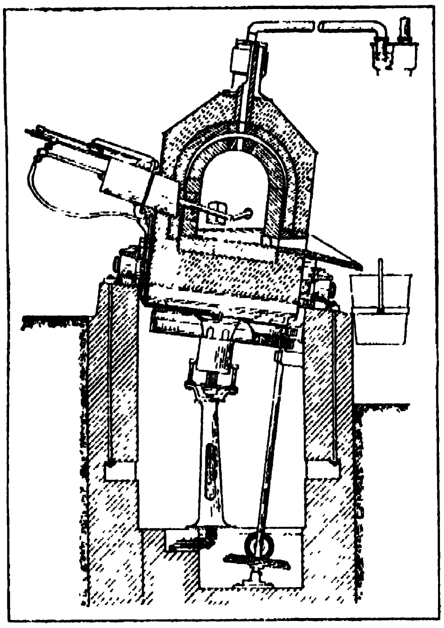


FIG 1 THE OLDER TYPE OF STASSANO FURNACE HAS A GYRATORY MOTION WHEN TURNED

for zinc smelting and was tested by Hansen (***) at the works of the General Electric Co., Schenectady, N. Y., in 1910. This furnace, shown in Fig 2, is a cylinder laid on its side, with two electrodes for single-phase current, one extending through each end. The electrodes are held by supports separate from the furnace shell and not moving with the shell The mounting of the furnace on rollers was evidently planned to allow turning the furnace over from time to time so as to interchange roof and hearth to equalize wear on the refractories, rather than to keep it constantly in motion. Two heats of copper were made in the furnace, operated stationary, but no brass was melted. The General Electric Co. then tried a stationary Stassano furnace for brass. This was soon abandoned and a different type of furnace was adopted.

No trials of brass melting in the moving form of Stassano furnace have been recorded Since none were made in the Weeks furnace it appears that the idea of avoiding surface overheating through stirring a melt of brass by moving an indirect-arc furnace while running, originated with the bureau of mines The first experimental test of this process was made on Aug. 25, 1915, in the little 35-kilowatt, 125-pound rocking furnace shown in Fig. 3. This furnace was designed to rock continually while melting The electrodes were supported by the end of the furnace and moved with it.

The furnace was rocked back and forth by hand as soon as the charge started to melt. The motion at first was through a small angle, then through a gradually increasing one as the charge melted, till, when all the metal was melted the furnace was rocked as far each way as was possible without allowing the metal to run up against the charging door.

Results With Red Brass

The idea of stirring the metal worked out nicely If the furnace was not rocked, it acted just as other stationary indirect-arc furnaces act, generating a high pressure of zinc vapor when yellow brass was melted, and showing a high metal loss. When it was rocked properly, local overheating of the surface was avoided by the stirring, the furnace could be kept tight, and the metal losses were low. Yellow brass ingot was melted with 1 per cent loss. Manganese bronze chips that gave 7.2 per cent net loss in an oil-fired crucible, gave 3 per cent net loss in the rocking furnace. Ingot containing 25 per cent zinc gave 0.5 per cent loss, red brass chips 1 per cent, red brass scrap 0.5 per cent, red brass ingot 0.2 per cent.

The furnace ran on red brass, poured at about 1200 degrees Cent. at the rate of 375 kilowatt hours per ton for 10-hour operation, and 325 for 24-

*Stassano, E., U. S. Patent 709105; Application of the Electric Furnace to Siderurgy, Trans. Am. Electrochem. Soc., Vol. 15, 1909, p. 70.

**Weeks, C. A., U. S. Patent 949511.

***Hansen, C. A., Electric Melting of Copper and Brass, Trans. Am. Inst. Metals, Vol. 6, 1912, p. 110.

hour operation. The consumption of graphite electrodes was about 3 pounds per ton. Not only was the metal loss practically as low as it was in electric crucible lift-out furnaces, but the power consumption was extraordinarily low for so small a furnace. Washing the roof portion with the metal absorbs the heat that in stationary furnaces is stored in the roof at a temperature higher than that of the bath. Leakage of heat from the roof is thus decreased. Internal heating of a charge is the most efficient way to heat it, and the rocking furnace might be said to accomplish the equivalent of internal heating, since intermittently the charge is between the source of heat and practically all the furnace wall. It appeared that this type offered one practical solution of the problem of finding an electric furnace that would operate on yellow brass as well as on alloys low in zinc. Through the co-operation of the Detroit Edison Co, Detroit, the bureau of mines was able to carry the experiment work further. This was done in a 1300-pound 200-kilowatt rocking furnace installed at the plant of the Michigan Smelting & Refining Co., Detroit. This furnace was started on May 9, 1917. It was tilted endwise, as well as rocked, in order to secure the maximum stirring. The experiments have been described *

Low Melting Loss

The tests covered alloys containing from 0 to 30 per cent zinc and 0 to 25 per cent lead. The metal loss on 100 tons of different alloys averaged 18 per cent less than that on the identical amounts of the same alloys melted in coke-fired crucibles in the same plant. The alloys were found to be thoroughly mixed by the stirring action of the furnace. The 1300-pound furnace produced 3 to 4 tons of red brass, poured at 1150 degrees Cent., with a power consumption of 335 kilowatt hours per ton, on one shift of 10 hours' operation. It melted 9 tons at 260 kilowatt hours per ton on a 24-hour operation. Both of these sets of figures are based on operation under the handicap of foundry delays in pouring, waiting for

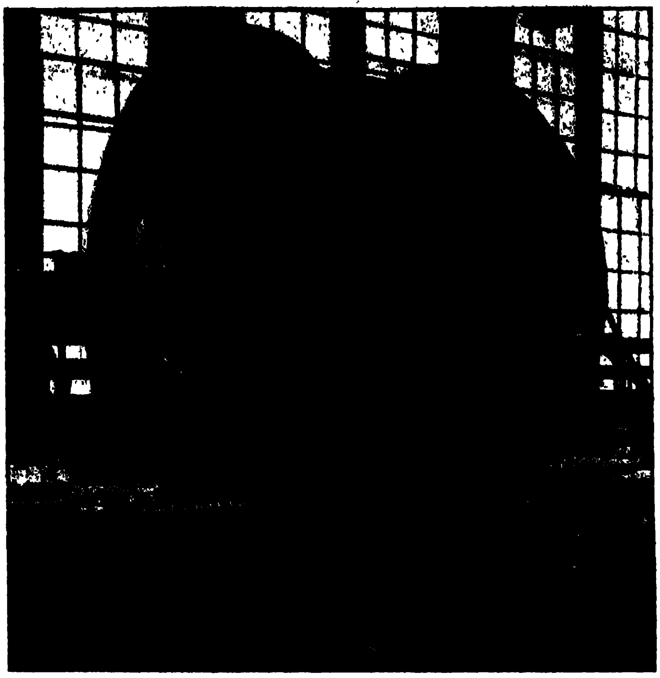


FIG 2—THE WECKS ZINC FURNACE WAS THE PIONEER TO ADOPT THE ROTATING PRINCIPLE

cranes, and the other usual causes. The rocking furnace was patened(**) and the patents assigned to the secretary of the interior as trustee. Free licenses to operate under the patents are granted on the recommendation of the bureau of mines. A license was taken out by the Detroit Electric Furnace Co, Detroit, which has incorporated in its design the improvements that were indicated by the tests of the experimental furnace

The Detroit rocking furnace has been described by St John (*) and is

FIG. 3 A SMALL ROCKING FURNACE WAS USED FOR EXPERIMENTAL PURPOSES

shown in Figs. 5 and 6, which show the general construction of the furnace. It is a cylindrical drum, lying on its side, but tilted a little in the supporting gear-rings to cause a greater stirring of the charge. The electrodes enter from the ends and are supported and adjusted by holders and slides attached to the ends of the furnace. Flexible leads and water hose allow the electrodes and water-cooled holders to be moved back and forth to control the arc, and to be drawn back out of harm's way while charging. The door which was made rather large to allow rapid charging, is taken completely off the furnace by a small jib crane before charging. It was decided that an attached door either would be in the way or would radiate heat to the discomfort of the operator while charging. The pouring spout is located beneath the door. The door need not be removed during pouring. Since the furnace can be rocked to any desired position the orifice can be turned uppermost for mechanical charging from a charging bucket. The furnace is rocked by a small electric motor and the reversal of the motor is automatically controlled by electrical contact. The change in the angle of rocking, that is, the time interval at which the motor is reversed, is controlled by the position at which a pair of arms are set on the rocking controller, shown nearest the switchboard in Fig. 5.

Special Lining

The furnace is lined with a layer of corundite brick, a very refractory brick, higher in alumina (Al_2O_3) than ordinary firebrick. Next to this is an intermediate layer of less refractory firebrick chosen for its heat insulating properties. The outer layer, next the shell, is of brick made from infusorial earth. The 1-ton furnace uses graphite electrodes 4 inches in diameter, though some installations are now being made with 5-inch electrodes. It takes 300 kilowatt seconds, single-phase, at about 120 volts, and the furnace and transformer together have a power factor of about 85.

The first heat was taken from a Detroit rocking furnace on Aug. 27, 1918, and in the next 19 months 30 other furnaces of this make went into operation and 15 were being installed. About a third of these furnaces are being operated steadily on yellow brass, the rest being in plants that operate them on various alloys, usually both red and yellow brass.

As is the case with all other furnaces, the output and the power consumption per ton vary greatly with the continuity of operation and the speed with which charging and pouring is done. The accompanying table summarizes

*Gillett, H. W., and Rhoads, A. E., Melting Brass in a Rocking Electric Furnace, Bull. 171, U. S. Bur. Mines, 1918. A Rocking Electric Brass Furnace, Jour. Ind. Eng. Chem., Vol. 10, 1918, p. 459; Foundry, Vol. 46, 1918, p. 314; Brass World, Vol. 14, 1918, p. 217; Met. & Chem. Eng., Vol. 18, 1918, p. 583.

**Gillett, H. W., and Lohr, J. M., U. S. Patent 1201284. Gillett, H. W., U. S. Patent 1201285.

*St. John, H. M., The Detroit Rocking Furnace for Melting Brass and Bronze, Metal Ind., Vol. 17, 1919, p. 329.

the performance of the 1-ton furnace under various conditions.

The power consumption per ton of metal, mostly red brass, at the Denny-Rine Co., Chicago, for the period Feb. 1 to Sept. 1, 1919, was 290 kilowatt hours. The furnaces were operated on both a 24-hour and a 10-hour basis during this time. The metal was poured into ingots, and the operation of the furnace was thus not subject to such delays as waiting for molds. Rapid charging and pouring were done. Even better figures than those given in the table are reported by St. John. (*) The rocking furnaces at the Michigan Smelting & Refining Co. averaged 304 kilowatt hours per ton on 6000 tons of red brass and bronze.

In one month's operation on red brass in a jobbing shop the power consumption on 200 tons of red brass averaged about 425 kilowatt hours per ton. During this run the shop was not operated at full capacity and consequently the furnace was not forced. Little attention was paid to speed in pouring and charging, so the furnace averaged as long on idle time between heats as the time required for the heat itself. Half the output was melted at around 375 kilowatt hours per ton, the higher figure for the total tonnage being due to badly delayed operation while melting the other half.

Low metal losses are obtained with this furnace even on alloys high in zinc as the table shows. One interesting point is that instead of waiting till the heat is almost ready to be poured before adding zinc, even on 60/40 brass made from new metals, the zinc can be added at the start of the heat, with less delay and no greater metal loss than when it is added at the end.

In a test on some 30 heats of red brass at the Fort Motor Car Co., Detroit, half of which were melted in an open-flame oil furnace and half in the rocking furnace, the charges to both furnaces having the same composition, determinations of zinc and lead showed an average of 2.53 per cent zinc and 1.54 per cent lead in metal from the open-flame furnace, and 4.05 per cent zinc and 1.65 per cent lead in metal from the rocking furnace. The time saving was found in a metal loss comparison, made by weighing charge and product, at another plant melting red brass in a rocking furnace and in a different type of open-flame furnace.

Metallurgist Reports

The metallurgist on one rolling mill states that no greater difference in analysis has been found in the first and the last metal from a heat of 60/40 brass poured from the rocking furnace than might be expected from duplicate analyses of the same sample. This indicates that the metal is thoroughly mixed. The degree of thoroughness of mixing, is also indicated by the analysis of the first ingot poured from the first ladle of a heat of highly leaded bearing bronze, which showed 25.40 per cent lead, and the analysis of the last ingot poured from the last ladle, which showed 25.25 per cent lead. The quality of the product has been found to be the same as that from coke-fired crucibles. The furnace can be drained thoroughly so that successive heats of different compositions can be made.

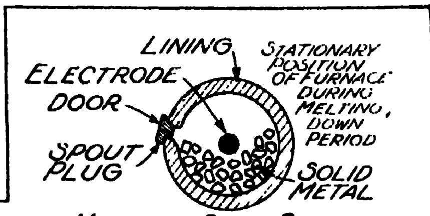
Of course, if the furnace has been used on a series of runs on 60/40 brass, for example, the lining will be impregnated with condensed zinc, and if the next heat were to be of pure copper for high conductivity castings, some of the zinc might be vaporized again and driven into the copper. In changing from one alloy to a widely different alloy which cannot tolerate some of the components of the first, any hearth furnace should be given a suitable wash heat. However, all common red and yellow mixtures can be handled one after the other without serious contamination.

While heat is stored in the walls, the heat stored when the metal is melted is at no higher temperature than is the charge itself. Therefore, there is no tendency for the temperature of the charge to rise after the current is shut off, as there is in furnaces whose roofs store much heat at a higher temperature than the charge. This allows a closer temperature control than is possible in any other type furnace save the induction furnace.

On single-shift operation the furnace is usually preheated half an hour before charging if the furnace has not been operated the previous day, but it is not necessary to do any night heating. The time and power used in preheating are, of course, included in the figures given in the table, and these figures are based on the power as metered on the primary side of the transformer.

The furnace gives good working conditions, can be closed tight to prevent

*St. John, H. M., Melting Nonferrous Metals and their Alloys in the Electric Furnace, Chem. & Met Eng., Vol. 22, 1920, p. 148



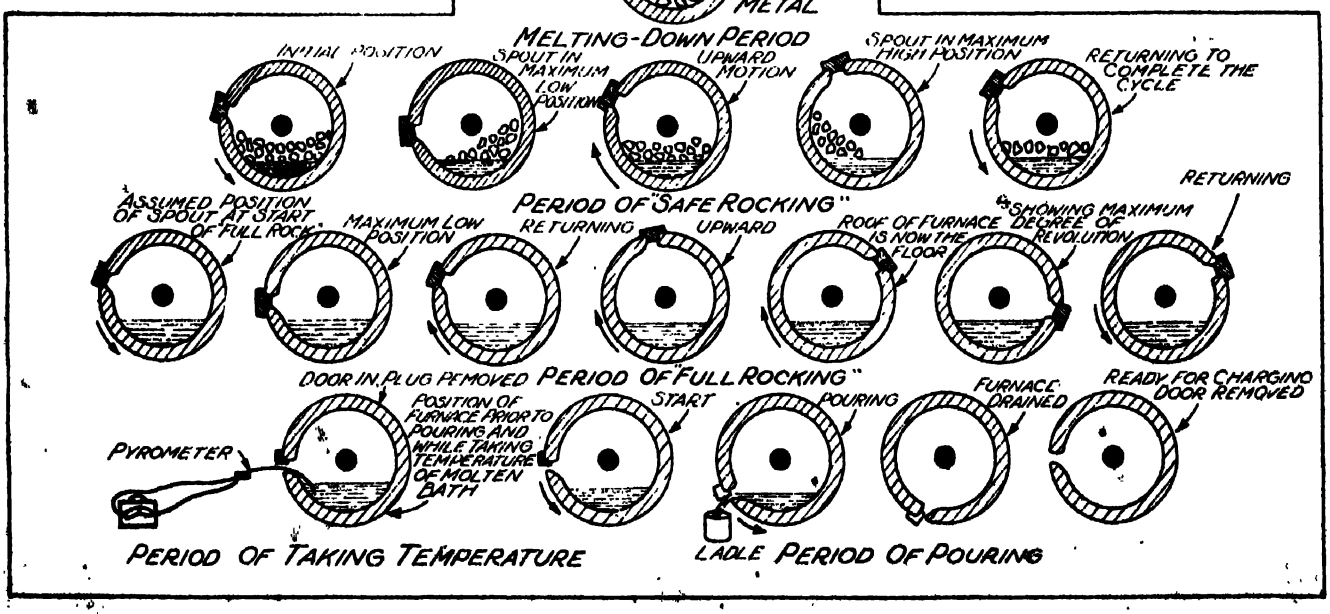


FIG. 4—DIAGRAMS SHOW POSITIONS OF THE FURNACE DURING MELTING, ROCKING AND POURING

DECIMAL PARTS OF A GROSS TON

To reduce railroad weights in pounds to tons and decimal fractions this table saves much computation. Assuming a carload of pig iron, scrap or coke weighs 90,680 pounds, the table in Data Sheet No 331 shows that 40 tons is 89,600 pounds, leaving a remainder of 1080 pounds, which the following table indicates is .4821 of a ton. The total carload therefore is 40.4821 tons. Multiplication by the cost per ton gives the exact cost of the carload and multiplication by the freight rate gives the exact charges.

TABLE OF DECIMAL PARTS OF A GROSS TON

Pounds	Decimal	Pounds	Decimal	Pounds	Decimal	Pounds	Decimal
1	0004	160	0714	410	1830	660	2946
2	0009	170	0759	420	1875	670	2991
3	0013	180	0804	430	1920	680	3036
4	0018	190	0848	440	1964	690	3080
5	0022	200	0893	450	2009	700	3125
6	0027	210	0938	460	2054	710	3170
7	0031	220	0982	470	2098	720	3214
8	0036	230	1027	480	2143	730	3259
9	0040	240	1071	490	2188	740	3304
10	0045	250	1116	500	2232	750	3348
15	0067	260	1161	510	2277	760	3393
20	0089	270	1205	520	2321	770	3438
30	0134	280	1250	530	2366	780	3482
40	0179	290	1295	540	2411	790	3527
50	0223	300	1339	550	2455	800	3571
60	0268	310	1384	560	2500	810	3616
70	0313	320	1429	570	2545	820	3661
80	0357	330	1473	580	2589	830	3705
90	0402	340	1518	590	2634	840	3750
100	0446	350	1563	600	2679	850	3795
110	0491	360	1607	610	2723	860	3839
120	0536	370	1652	620	2768	870	3884
130	0580	380	1696	630	2813	880	3929
140	0625	390	1741	640	2857	890	3973
150	0670	400	1786	650	2902	900	4018

(*Concluded on Data Sheet No 334*)

DECIMAL PARTS OF A GROSS TON

(*Concluded from Data Sheet No 333*)

TABLE OF DECIMAL PARTS OF A GROSS TON

Pounds	Decimal	Pounds	Decimal	Pounds	Decimal	Pounds	Decimal
910	4063	1260	5625	1610	7188	1960	8750
920	4107	1270	5670	1620	7232	1970	8795
930	4152	1280	5714	1630	7277	1980	8839
940	4196	1290	5759	1640	7321	1990	8884
950	4241	1300	5804	1650	7366	2000	8929
960	4286	1310	5848	1660	7411	2010	8973
970	4330	1320	5893	1670	7455	2020	9018
980	4375	1330	5938	1680	7500	2030	9063
990	4420	1340	5982	1690	7545	2040	9107
1000	4464	1350	6027	1700	7589	2050	9152
1010	4509	1360	6071	1710	7634	2060	9196
1020	4554	1370	6116	1720	7679	2070	9241
1030	4598	1380	6161	1730	7723	2080	9286
1040	4643	1390	6205	1740	7768	2090	9330
1050	4688	1400	6250	1750	7813	2100	9675
1060	4732	1410	6295	1760	7857	2110	9420
1070	4777	1420	6339	1770	7902	2120	9464
1080	4821	1430	6384	1780	7946	2130	9509
1090	4866	1440	6429	1790	7991	2140	9554
1100	4911	1450	6473	1800	8036	2150	9598
1110	4955	1460	6518	1810	8080	2160	9643
1120	5000	1470	6553	1820	8125	2170	9688
1130	5045	1480	6607	1830	8170	2175	9710
1140	5089	1490	6652	1840	8214	2180	9732
1150	5134	1500	6696	1850	8259	2185	9754
1160	5179	1510	6741	1860	8304	2190	9777
1170	5223	1520	6786	1870	8348	2195	9799
1180	5268	1530	6830	1880	8393	2200	9821
1190	5313	1540	6875	1890	8438	2205	9844
1200	5357	1550	6930	1900	8482	2210	9866
1210	5402	1560	6964	1910	8527	2215	9888
1220	5446	1570	7009	1920	8571	2220	9911
1230	5491	1580	7054	1930	8616	2225	9933
1240	5536	1590	7098	1940	8661	2230	9955
1250	5580	1600	7143	1950	8705	2235	9978

Summary of Performance of 1-ton Detroit Electric Furnace at Various Plants

Alloy	Firm	Number tons on which figures are based	Hours furnace operated per day	Output per day tons	KWH per ton	Pounds electrodes per ton	Per cent metal loss, including nonmetallic material in charge Gross	Net	Remarks
Red brass	Michigan Smelting & Refining Co.	178	20	9	310	...	3.5	0.65	Much oily borings in charge
Phosphor bronze	Aluminum Manufactures, Inc.	42	9	4	330	...	....	....	Metal poured at 1250° C. Poured in 8 ladles per heat.
Red brass	Sherwood Brass Co.	92	9	4	340	4	....	....	
Red Brass 10% zinc	Denny-Rine Co.	(a)	24	16	270	2¾	3.6	0.70	Zinc added as oily yellow borings, 1600-lb. heats.
Pure copper	Wheeler Condenser Co.	37	24	9	360	...	0.34	...	Line voltage, low—power input too low making output low and power consumption high
All red brass borings	Denny-Rine Co.	(b)	24	21½	240	2¼	....	....	2200-lb. heats
Red brass	Gen. Al. and Brass Mfg. Co.	34	9½	6½	200	3½	0.44	....	Metal poured at 1140° C.
Brass of 18% zinc	Michigan Lubricator Co.	37	9	5	315	3¼	2.5	0.9	
Red brass	White & Bro.	97	10	..	330	...	....	....	
60/40	C. B. Bohn Fdy.	14	6	4	325	...	1.68	1.03	
60/40	Detroit Copper & Brass Rolling Mills	34	9	6	275	...	....	0.9	
60/40	Detroit Copper & Brass Rolling Mills	(a)	16	10	250	3¾	....	under 1%	
60/40	Cleveland Brass and Copper Rolling Mills	33	8	6	220	2½	1.0	....	
60/40	Chase Metal Works	500 (b)	16	14	240	...	....	1.02	
60/40	Chase Metal Works	170 (b)	8	6½	280	...	....	....	
Manganese bronze	Oregon Brass Works	15	6 to 8	3½ to 4	270	...	2.84	....	

(a) Average operation. (b) Test operation.

egress of zinc fumes, and is cool in operation. In one plant using both fuel-fired and rocking furnaces, the rocking furnaces were kept operating on some hot summer days when the operators of the fuel-fired furnaces would not work on those furnaces. One plant's figures show the labor cost per ton on the rocking furnace to be between 50 and 60 per cent of that on coke-fired crucibles. Another plant figures that its total melting costs have been cut 50 per cent by replacing coke-fired crucible furnaces by the rocking electric furnace.

Too little data is available on the smaller sizes to establish fully their possibilities and limitations. The first furnaces of the 1000-pound and 500-pound sizes have but recently been installed, and they have not been operated as yet up to full capacity.

The 500-pound furnace at the Hills-McCanna Co. operated to give four heats, or 1 ton, in eight hours uses about 385 kilowatt hour per ton on red brass. On 14 heats, the furnace only being operated two or three heats on most of the days, the power consumption on red brass was about 425 kilowatt hours per ton. The last heats of the day indicate that the furnace would melt at about 300 kilowatt hour per ton on 24-hour operation.

The 1000-pound furnace, at the Oregon Brass Works, operated to average about five heats, or 2½ tons in eight hours, gave an average power consumption of 350 kilowatt hours per ton, on 60 heats of red brass, gun metal and leaded bronze. The last heats of the day indicate that on 24-hour operation it would run at about 250 kilowatt hours per ton.

On the score of metallurgical fitness, metal losses and general versatility, this type of furnace is a distinct advance over the direct-arc type. Its reduced labor cost and metal losses, its elimination of crucibles, and its high thermal efficiency, make it show savings over fuel-fired furnaces. Its thermal efficiency is better, under the same conditions of operation than that of any other type in use, save the induction furnace. This might be expected from a theoretical point, since the induction furnace generates heat in the metal itself, and the rocking type shows the next closest approach to internal heating.

Because the furnace must be constructed to allow rocking, it is im-

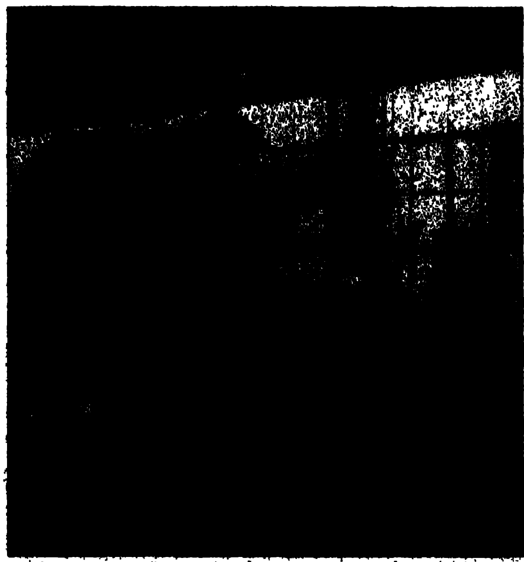


FIG. 5—A 1-TON DETROIT ROCKING FURNACE WITH JIB CRANE FOR HANDLING THE LADLE

FIG. 6—THE SUCCESS OF THE DETROIT FURNACE IS SHOWN BY A NUMBER OF INSTALLATIONS IN THE SAME FOUNDRY

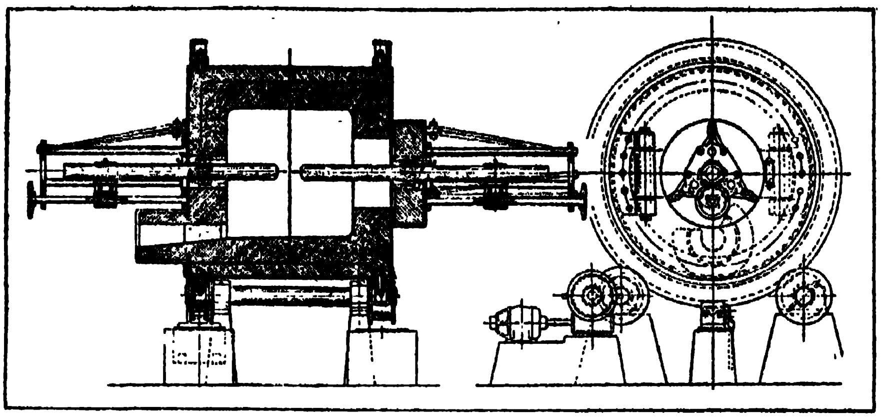


FIG. 7—GENERAL ASSEMBLY OF THE DETROIT ROCKING ELECTRIC BRASS FURNACE

possible to put on a spare roof when the roof portion of the lining fails, as is done in both stationary direct and indirect arc furnaces. The lining is of course cooled as the charge washes it, so that its temperature at the end of a heat is not above the pouring temperature of the charge, and this protects the lining. If the furnace is held stationary when operating on bronze where rocking is not so essential to prevent loss, the roof portion of the lining may be badly damaged in a few heats. This indicates that the rocking furnace should be rocked, even on bronze.

There is some tendency to erosion by the moving charge, but this is not marked. Slight repairs to the refractories may be made by turning the furnace so that the damaged part is at the bottom, then patching and heating the furnace to set the patch while it is held in place by gravity.

The lining life is usually about 350 heats, although 600 heats are often obtained, and 700 to 800 heats from a lining are not uncommon figures. Usually only the inner course, that of corundite brick, needs replacement. The brick for this on the 1-ton size costs about $100. Labor for relining is said to cost about $50.

Care is of course necessary to keep the rocking control mechanism, gears, and bearings cleaned and lubricated, but, with reasonably careful treatment, the reliability of the furnace is good. Some of the first furnaces had trouble with gears and bearings, but experience brought improvements in design and in materials used which overcame this.

Besides inability to quickly put on a new roof, there are some other drawbacks to this type. If the furnace is rocked too far before the charge is sufficiently melted, ingots or heavy scrap may be carried up so high that they fall on the electrodes and break them. This danger will be made apparent by Fig. 4. That this danger can be overcome is shown by the low electrode consumption listed in the table.

In operating on alloys high in zinc some zinc usually condenses on the electrodes within the furnace wall. If this is allowed to freeze, it will cause the electrode to bind. Therefore, on single-shift operation on yellow brass, the electrodes should be pulled out of the walls and cleaned at night. The water cooling about the electrode should be so adjusted as to allow the electrode to run hot enough to keep the condensed zinc in a molten condition.

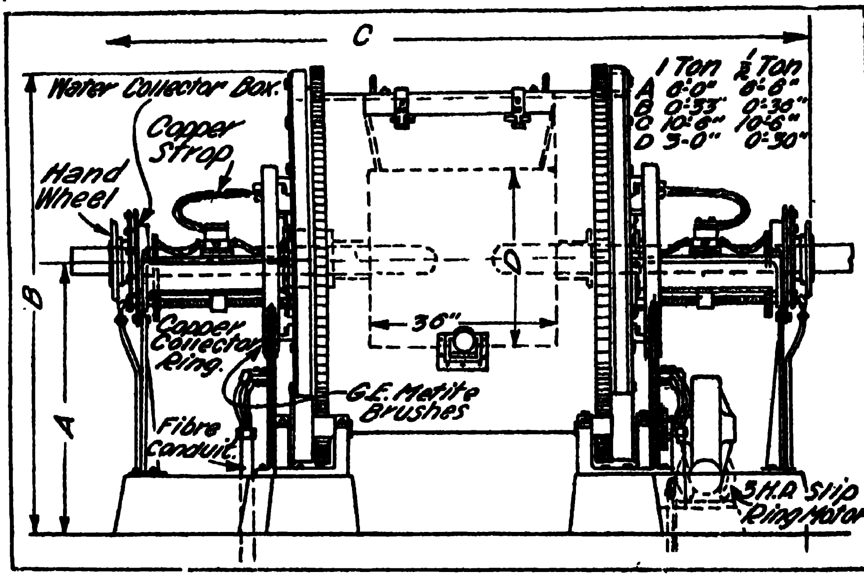


FIG. 9—DESIGN OF THE ROTATING ELECTRIC BRASS FURNACE MADE BY THE AMERICAN METALLURGICAL CORP.

The furnace has another difficulty common to arc furnaces. When the charge contains a great proportion of oily borings the oil must be distilled out quite completely before starting the arc, since oil vapor is a nonconductor of electricity and the arc will not hold steadily in such a vapor. Up to 25 pounds of oil in a 1-ton charge will burn out at once if the oily borings are charged into the hot furnace before the rest of the charge. This is also advisable in that they serve as a cushion over the hearth when the heavier material is dumped in. A charge consisting entirely of borings with 4 per cent, or 80 pounds of oil, involves a few minutes delay to allow the oil to be driven off.

The most serious drawback is the fact that the 1-ton furnace takes a 300 kilowatt single-phase load, which makes it unsuited for very small gen-

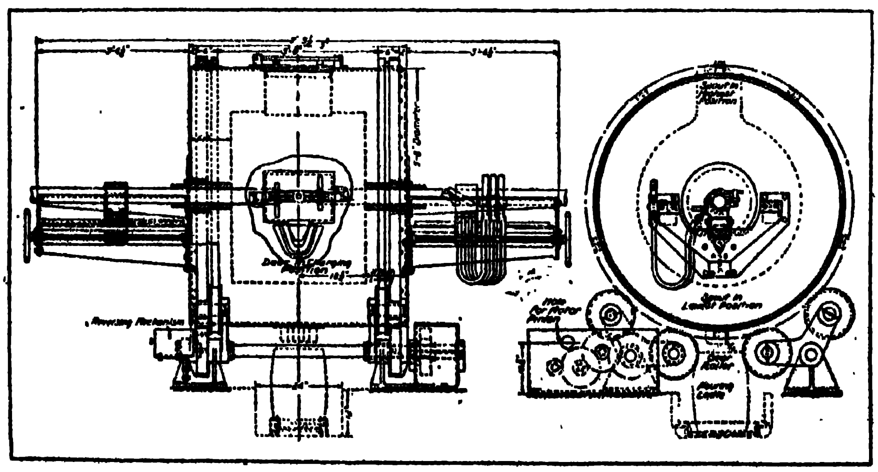


FIG. 8—DETAILS OF THE BOOTH ELECTRIC ROTATING BRASS FURNACE

erating stations or low capacity transmission lines. Of course, two or three sets of arcs, each on a phase, could be used, but such a design would complicate the furnace. By the use of suitable reactance, surges are minimized without bringing the power factor below about 85, and the furnaces have been an acceptable load to the central stations to whose lines they are connected. Smelting and refining plants offer a field for a furnace of more than a ton capacity, and a large two-phase furnace is being built for such use.

Forty 1-ton, two 1000-pound and three 500-pound Detroit rocking furnaces have been installed or ordered for melting brass. The prices f.o.b. Detroit of the Detroit Rocking furnace, including transformers, motor, switchboard, meters and all other equipment were quoted on Feb. 24, 1920, as follows: 500-pound size, $6500; 1000-pound size, $8500; 1-ton size, $11,500. Automatic electrode control is supplied at about $750 extra. The 1-ton size, in a nose-tilting type, is quoted at $12,750.

Two other furnace makers have recently put out furnaces of this type. Their points of difference are shown in Figs. 7, 8 and 9, which show respectively the design of the Detroit rocking furnace, the Booth rotating furnace, and the rocking furnaces made by the American Metallurgical Corp., Philadelphia. The 250-pound Booth furnace is also shown in Fig. 10.

The Detroit furnace charges on the side, rocks back and forth, and has its leads solidly fastened to the electrode holders, the cables swinging as the furnace rocks. (*) The Booth furnace, made by the Booth Electric Furnace Co., Chicago, has no opening on the circumference. It is charged through a door at one end which also carries the electrode and its support. It has a tap hole at the other end, carries current to the furnace by sliding contacts, and rotates the furnace instead of rocking it. The first heat was made in a Booth furnace on May 17, 1919. The furnace was of 250 pounds capacity and was installed at Leitelt Bros., Chicago. Early a 500-pound Booth furnace went into operation at the plant of the Cleveland Brass Mfg. Co., Cleveland. No other installations are known to the writer to have been completed on March 1, 1920, but it is stated (**) that 20 furnaces have been sold.

The furnace made by the American Metallurgical Corp. is said (***) to be patterned after the Weeks zinc furnace, but instead of the stationary electrodes supported outside the furnace, the supports are attached to the furnace shell and move with it. The furnace is designed to be kept in motion during melting, and while termed a *rotating* furnace, it has "a system of automatic switches by which the drum can be rotated to any percentage of the circumference at the will of the operator." The charging door is on the side, and hence a rocking motion rather than complete rotation seems to be contemplated. The current, as in the Booth furnace, is carried on sliding contacts.

No furnace of this make was yet in operation on March, 1920, but one of 1000-pound capacity, was being installed at the York Hardware & Brass Co., York, Pa.

Sliding contacts and complete rotation were both considered in the design of the rocking furnace by the bureau of mines. The first was not considered desirable, for while a current of 500 to 1000 amperes taken by a small furnace might readily be so carried, the carrying on a sliding contact of the 2000 to 3000 amperes needed by a 1-ton furnace seemed less reliable than flexible leads with solidly fastened contacts. It may be granted the furnace would look better without swinging cables, but it would not be likely to act better. Trouble would be experienced amid the dust and dirt of a foundry in keeping clean the sliding contacts.

In his later moving furnaces Stassano went to great pains to provide a construction which would replace the earlier sliding contacts by permanent solid contacts. (*)

Complete rotation seems unpromising, because rocking too far in a large rocking furnace before the charge is

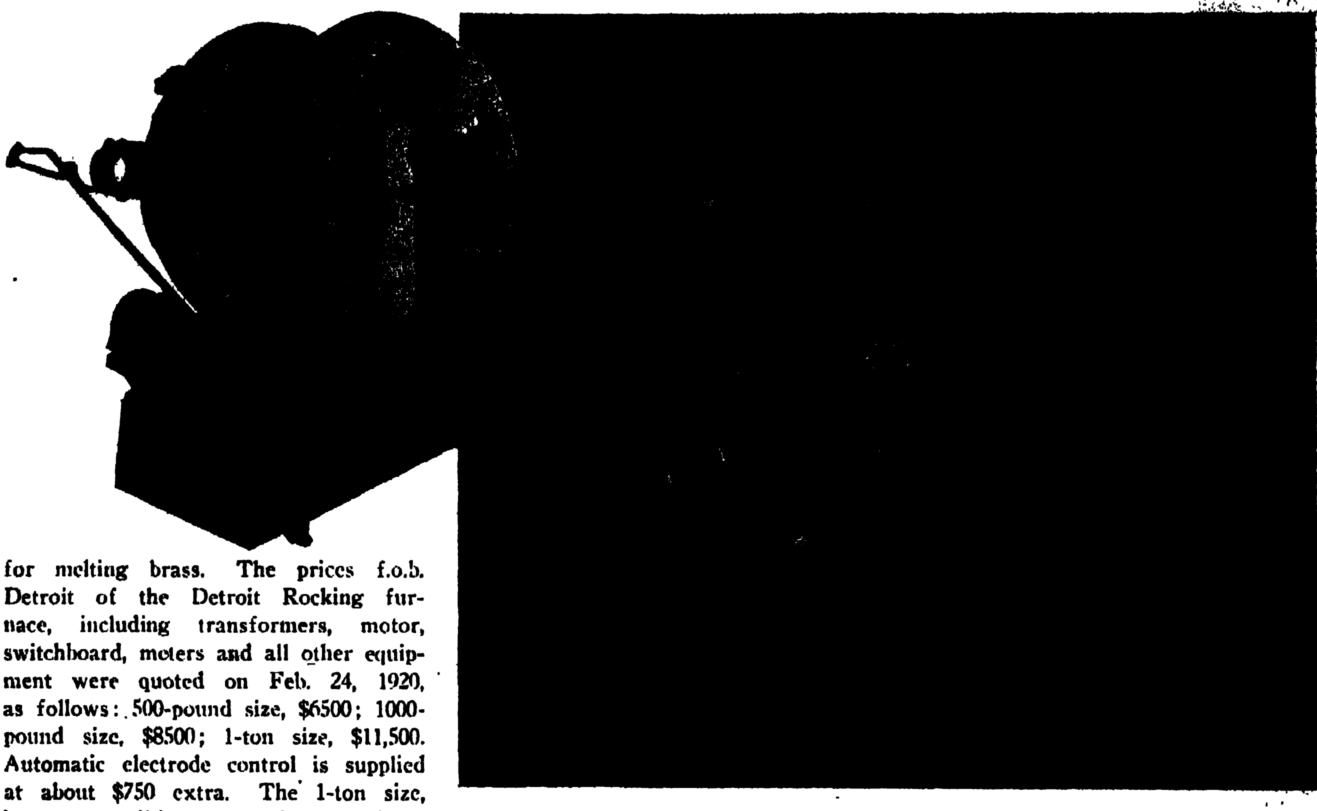


FIG. 10—THE CHARGE IS POURED FROM THE END IN THE BOOTH ELECTRIC ROTATING BRASS FURNACE, THE TAPPING HOLE BEING DIRECTLY UNDER THE ELECTRODE

*Booth, C. H., The Booth Electric rotating brass furnace, Booth, W. K., U. S. Pat. 1322795, March 2, 1920. Iron Age, Vol. 105, 1919, p. 1690. Metal Ind., Vol. 17, 1919, p. 317. Chem. Met. Eng., Vol. 21, 1919, p. 437, Vol. 22, 1920, p. 186. Electrical World, Vol. 74, 1919, p. 1187.

**Metal Industry, N. Y., Vol. 18, 1920, p. 107.

***Ryan, F. J., Week's Electric Rotating Furnace as Applied to the Brass Industry, Metal Ind., Vol. 17, 1919, p. 510.

**Metal Industry, N. Y., Vol. 18, 1920, p. 107. 1105559. Schmelz, E. M., A New Electric Steel Casting Plant, Met. & Chem. Eng., Vol. 11, 1913, p. 709.

sufficiently melted has in the writer's experience been synonymous with broken electrodes and much trouble on a normal charge. Charges of all borings, where the change is not in large enough pieces to break the electrodes when they fall on them, do not require as much care while rocking the furnace. The 125-pound laboratory rocking furnace did not require much care even when ingots were melted.

If rocking or rotating is delayed on red brass till danger of electrode breakage is past, the lining will have more severe punishment, as in such a proceeding it is cooled by the melt for a lesser time. The writer's experience on yellow brass has been that delaying rocking till the charge is sufficiently melted to allow full rotation fails to stir the charge soon enough to avoid surface overheating. This causes such excess zinc pressure that the furnace will not stay closed, and large metal loss is experienced.

Fortunately a 1-ton Booth furnace is to be installed at the Michigan Smelting & Refining Co., for comparison with the four Detroit rocking furnaces there, so a decisive answer to the question will ultimately be made.

The 250-pound Booth furnace gave about the results to be expected from its similarity to the 125-pound rocking furnace. In a month's operation on a 9-hour schedule 18 tons, mostly red brass, were melted at 480 kilowatt hours per ton average. This amounted to about 1700 pounds in nine hours. Some days the power consumption was as low as 400 kilowatt hours per ton. Metal losses were 0.8 per cent on red brass and 1.4 per cent on yellow brass. Electrode consumption was 4 pounds of graphite per ton. The power factor of the furnace itself is 71 and of furnace plus transformer 63. This is below the point usually allowed and generally entails a penalty on power bills. The 250-pound Booth furnace is understood to be priced at about $3000, without transformer, primary switch, etc., which would raise the cost to around $4000.

One advantage claimed for the Booth furnace is that it can be picked up bodily by a crane for direct pouring. This might be an advantage in small sizes, but until it is actually tried out its value is unknown. The avoidance of an opening in the circumference of the furnace would give more stability to the lining and tend to increase lining life. If this could be done without involving electrode breakage it would be useful. However, it involves some difficulties in large furnaces due to the necessity of mounting the electrode support on the only available point, the door.

Whether the deviations from the rocking furnace design, shown by the later adaptations of the scheme of moving an indirect-arc furnace, are improvements or not will be shown when the later forms have had real commercial tests on furnaces of reasonably large capacity. Whatever the final embodiment of the rocking-furnace idea may be, it appears that the furnace in its present form shows ability to melt both brass and bronze economically.

There are at least 65 furnaces of this general type in use, or being installed for brass and bronze melting, with a total load of around 17,500 kilovolt-amperes. All other types of electric brass furnaces in use or being installed are calculated to have a total load of around 15,000 kilovolt-amperes. More than half of the total production of electric brass is made in furnaces of the rocking type, although the other types which average much smaller output per furnace, outnumber them.

The rocking-type furnace is then, one of the solutions of the brass-melting problem. Other types of furnaces which also offer solutions of the problem will next be discussed, after which the adaptability of the various types to different plant conditions will be considered briefly and with regard to practical conditions.

Recommends Standard Sizes for Shafting

THE desirability for reducing the number of sizes of shafting and in consequence the number of parts of power-transmission equipment that must be carried in stock long has been recognized. At the suggestion of the chairman of the committee on war industries readjustment of the American Society of Mechanical Engineers, a committee was formed to investigate the subject of the standardization of shafting sizes.

This committee was confronted with two distinct but closely related problems, viz., the standardization of the diameters of shafting used for the transmission of power; and the standardization of the diameters of shafting used by machinery manufacturers in making up their product.

A letter was sent to 36 of the largest manufacturers and dealers in transmission shafting asking for statistics on the consumption of each size of shafting handled by them. Some 20 of the largest concerns furnished complete statements of sales over periods of time chosen by themselves. These data were reduced by the committee to a uniform basis of percentages and plotted in the form of a diagram. From the diagram, it was evident which of the sizes were popular and generally sought.

In the letters to these firms, the committee expressed the opinion that the custom of using shafting 1/16 inch under the unit size is so firmly established in this country that it would be unwise to attempt to adopt sizes in even inches and fractions as standard. It also was pointed out that certain sizes stand out prominently as popular sizes and that others are sold in relatively small quantities. It seemed quite feasible to select a series of standard sizes which would meet the popular demand and give a sufficient selection of sizes for general purposes and at the same time reduce the number of sizes now listed by the trade from some 50 or 60 down to 12 or 15.

The committee decided to lay the plan before some 225 large consumers of this material and invite their comment upon its desirability or feasibility and their advice as to the size interval between standard diameters which should be considered. In the case of machinery shafting the users were unanimous in their approval of the plan to standardize sizes, but recommendations as to size interval varied greatly. However, these recommendations, in so far as they were definite and specific enough, were tabulated and a diagram constructed showing the relative popularity of the various size increments for each inch of diameter. The net result of the investigation was to narrow down the standard to 15 sizes.

With these data accumulated and sifted down to usable form the committee felt that it was in a position to present its information and preliminary deductions to representatives of other interested organizations.

Having completed the first part of the work the committee submitted a progress report to the council in which it recommended the adoption and approval of the following lists of sizes as standard for the society:

Transmission Shafting in inches:

15/16, 1 3/16, 1 7/16, 1 11/16, 1 15/16, 2 3/16, 2 7/16, 2 15/16, 3 7/16, 3 15/16, 4 7/16, 4 15/16, 5 7/16, and 5 15/16.

Machinery Shafting:

Size intervals extending to 2½ inches by sixteenth inches; from 2½ inches to 4 inches, inclusive, by eighth inches; from 4 inches to 6 inches by quarter inches. This should simplify matters.

Standard Foundry Cost System-I

Predetermined Rates Explained—Cost Plan Divided Into Sections — Routine of Material, Labor, Expense and Production Are the Four Divisions Considered in This Article—Expense Account Numbers Tabulated

COMPILED BY

C. E. KNOEPPEL & CO., INC.

NEW YORK

IN PRESENTING this revision of the original bulletin on the cost accounting system no attempt is made to provide for all possible forms used in handling the various lines of routine of the general business operations. It is assumed that all companies have adequate purchasing and commercial accounting systems which would bring all purchases of materials, labor and expense items to certain prescribed ledger accounts, and that adequate invoicing methods are in vogue for sales. Only such documents as are actually necessary for the accounting of the costs will be mentioned in this bulletin in order to simplify the presentation.

Plan of the System

The plan of costs shown herewith is simple and is briefly outlined as follows:

The scheme really consists of three main stages:

First:

The proper distributing of purchases of material, labor and miscellaneous expense items to certain proper control accounts subject to further accounting by requisition, time cards, etc., to the proper cost accounts.

Second:

(a) The proper accounting of the use of materials, labor, etc., to productive and expense orders, and the transfer of same by summarized monthly journal entries, to the cost control accounts.

(b) Also the transfer from the cost accounts of metal and overhead accounts of the proper cost amounts at predetermined rates to the work in process account by journal entry

Third:

The compilation of costs of product, which, summarized for the month, credit the work in process and charge sales cost by journal entries.

Before proceeding further it should be perfectly clearly defined in each mind the meaning of "predetermined rates."

In foundry costing particularly, the feature of predetermined rates is by far the greatest feature. Metal cost must be by pound of metal poured; molding and core burden by percentage on direct labor by each department; finishing cost by percentage on molding and core direct labor combined; annealing cost by pound on good castings, etc.

But even though we find the actual cost of each of the preceding monthly, it is absolutely improper, unfair and really impossible to use the actual figures of any one month or small group of months in the figuring of costs.

Take, for instance, the cost of melting. Last month we operated smoothly with no repairs of any great amount. This month quite a bit of brick repairs were necessary. Then suppose that next month something went wrong with the blower and we had a very heavy cost of repairs in damages done the cupola. In open-hearth furnaces this feature is very pronounced, as 300 heats may slide along smoothly and then start troubles resulting finally in a complete tear down to the checkers. Or perhaps even the checkers are plugged up. The same applies in perhaps less extent in all the burden and pound cost accounts.

It is apparent, therefore, that no one month's cost can fairly be taken. Nor even a small group of months. In fact, to be nearest safe, the average of a complete year and even more should be taken as the rate to be used in both estimates and actual costs, for each of the divisions mentioned in the second paragraph.

System Is Basic

Several years ago, the American Foundrymen's association arranged with C. E. Knoeppel & Co., Inc., industrial engineers, to compile a cost accounting system applicable to all classes of foundries. This was prepared after careful study, and was sold to members of the association. Its value to those who adopted the plan induced the association to publish the details in full in the proceedings for 1919. Built on broad general lines, the system may be adapted with a little study to the needs of practically any foundry regardless of its size or the class of work handled. It furnishes a common method of analysis, which if generally adopted, will give assurance that castings may be bought and sold upon a sound basis of actual cost plus a reasonable profit.

Bear in mind, however, that the actual cost of each rate is found each month, and in such detail that steps can be taken to study and improve the operating methods in order to make the average or predetermined rate good. In fact, the constant goal should be to beat it and make money by so doing.

In melting cost, molding burden-direct labor and all such cost accounts distributed by percentage and pound rates, the basis should be arrived at by using figures of expense. The basis on which the expense is figured should be at least a year's operation. Of course in starting new, this will be difficult; but this should be the aim.

Machine Hour Rates

In arriving at the predetermined rate per hour of the molding burden-machine hour, and the coremaking burden-machine hour, a little different procedure holds. Similarly to the preceding accounts, find as closely as possible the maintenance charges covering at least a year of all the machines the time of which is to be charged for; that is, all in the molding department in one group, and all in the core in another group. Then arrive at the total power charge for each group. Finally, assemble the proper depreciation for each group. All three of these items will of course be figured by each machine which enters into each group.

Next, compute the total machine hours possible, which is the number of normal working hours of your plant times the number of machines in each group. Then take 85 per cent of the total possible hours in each group as the basis of your rate. Finally divide the total cost for the period by the 85 per cent of total possible hours, thereby arriving at the standard rate to use.

In regular monthly working, it will be best to use the actually employed machine hours as the basis of monthly costs, as shown by the cost statements.

Cost Plan in Greater Detail

In more detail, the cost scheme deals with the subject as follows: The headings shown are those which appear on the cost sheet whereon the cost of a casting or classes is figured.

Direct Labor is charged to production orders which represent either individual patterns or classes of work. This labor consists only of that which is directly chargeable to the product manufactured. All other labor entering into pound or percentage rates is classed as indirect labor.

Metal Cost is assembled monthly in a melting cost account. This account is credited with the actual

metal poured at the predetermined rate, the balance showing whether operating over or under the proper rate.

Molding Burden Direct labor is assembled monthly in the molding burden account, which account is credited at close of month with the amount of burden represented by the predetermined percentage of the actual direct molding labor for the month. The balance indicates whether operating over or under the required rate.

Molding Burden-Machine Hour is assembled monthly in the molding burden-machine hour account, and is credited at close of month with the amount represented by the actual number of machine hours consumed for its month on productive work at the predetermined rate per hour. This predetermined rate is designed to be figured on the basis of a ton; average cost of items shown in the detailed directions later, divided by 85 per cent of the total possible machine hour of the equipment.

The balance remaining indicates whether operating above or below the required rate.

Core Burden-Direct Labor is assembled monthly and is treated same as molding burden except that core direct labor is the basis for percentage.

Core Burden-Machine Hour is operated for machine equipment for core department, exactly the same as for molding department.

Molding Sand Expense

Flask Expense—These two costs will in most cases be a part of the molding burden and are so shown here. But in steel plants particularly, they may be treated as separate costs, and are so arranged for in detailed expense classification. If so, they will be entirely eliminated from the molding burden, and a separate cost statement made for each. In this case the basis of predetermined rate for molding sand will be metal poured, and flask expense will be on basis of good castings.

Finishing Cost is assembled monthly and is treated same as molding and core except that combined molding and core direct labor is the basis for percentage.

An exception to this is in plants large enough to treat direct operations in this department as direct labor, in which case its own direct labor charged to production orders will become the basis for distribution of its burden, same as in molding and core departments.

Annealing Cost is assembled monthly in an account of same name, which account is credited with amount represented by number of pounds good castings at the predetermined rate per pound. The balance indicates whether operating over or under the required rate.

It might be stated here that the real correct basis for this cost should be the weights of castings *annealed* rather than the basis of total good castings produced. Those who will tally the castings annealed will get far more accurate costs by so doing, as this eliminates castings not annealed and brings in castings re annealed as is often the case.

Actual Cost Sheet (also as estimate sheet) In order to assist in understanding the details following, it is suggested that at this point, immediately after reading the preceding pages, a study be made of the actual cost sheet data shown under Section V, "Cost Compilation." This will aid very much in understanding the details leading up to the costs and cost statements as shown.

The presentation of the methods following is divided into sections, each section representing a particular phase.

Section I—Material Routine; Section II—Labor Routine; Section III—Expense Routine; Section IV—Production Routine; Section V—Cost Compilation; Section VI—Journal Entries; Section VII—Plant Investment Classification; Section VIII—Depreciation; Section IX—General Ledger Accounts.

Section I
Material Routine

MATERIAL accounting presents particular difficulties due, probably, to the fact that it deals with tangible things and that practically all transaction are directly traceable as used for a particular purpose or as benefiting a particular department.

The material forms principally required for costkeeping purposes are:

1. Stock ledger (card or sheet).
2. Material requisition.
3. Material credit memorandum.

1. *Stock Ledger*—The stock ledger should be a complete record of each item of material showing quantity required, ordered, received and issued, and the unit and total value of such material.

Material accounts should be maintained in the general ledger representing at closing periods the value of materials on hand supported by the details of the stock ledger sheets or cards, which form a detailed analysis of each control account.

2. *Material Requisitions*—Material withdrawn from stock must be accounted for in the following manner, all requisitions, etc., showing clearly the use of, and order number chargeable with the materials used:

Melting Materials

The furnace or cupola reports, made out daily by the weigher or storeskeeper, give the quantity and kind of melting and fuel materials used, and the account numbers to be charged. From these reports the stores ledger is posted and the unit prices thereon are noted on the furnace reports and the amounts derived.

The furnace reports may then be sent to the cost department to serve as the basis for the charges, each month, to the expense accounts involved, or instead, classified material requisitions may be made up monthly and sent to the cost department.

Miscellaneous Materials

All material not included on the furnace report should be the subject of a material requisition made out at the time of withdrawal of material from stock. The course of the material requisition is as outlined above. The disposition of the requisition and the charges it carries will be treated of presently.

Recovered Material

Recoveries of over-iron, shot, spills, etc., should be shown on the daily cupola or furnace report.

3. *Material Credit Memoranda*—Material credit memoranda simply reverse the charge made on material requisitions and represent unused material being returned to stock for which corresponding credit must be given.

Note:—As far as possible all material should be kept in a neat orderly manner in well regulated stock rooms. Otherwise, it is exceedingly difficult to enforce requisition regulations.

Also all issuances of material should be accounted for with accuracy. Pig iron, scrap, and all materials should be carefully weighed; it is little use to run a cost method on guessed quantities.

Entering, Requisitions, Etc.

As requisitions for materials used are received by cost department, they will be entered on stock ledger, and priced and extended at the unit values shown on stock ledger.

Before filing under order numbers, the requisitions representing material drawn from each separate material control account should be added each day, and the total withdrawals for each control account entered on an accumulation sheet to run for the current month. The totals for the month of this accumulation sheet become the credits to the material control accounts in the monthly journal entry of distribution of materials. The debits of this entry are to the various expense accounts as described later.

Under "Expense Routine" is described in greater detail the use of the expense ledger charge slip, which in a large measure is like a material requisition, except that it charges material or service charges direct from the purchase entry to the expense accounts. This covers a large class of charges of intangible and evasive nature which are not properly or safely run through regular stock material accounts subject to requisition.

Section II
Labor Routine

LABOR accounting has two main elements—payroll compilation and labor distribution. Payroll compilation is comparatively simple, if the time has been correctly reported and recorded. Payroll compilation is merely the weekly summarizing of the wages earned by each employe daily. Labor distribution is the correct apportionment of wages against production orders or classes (direct labor). The chief difficulty is in the incorrect reporting of applied time by the men, faulty counting or reporting by the inspectors, incorrect scale reports and clerical errors by the timekeepers. As many safeguards as practicable should be adopted to insure the correct reporting of time, accurate counting and inspection reports and accurate clerical operation in the transcription of data.

The labor forms principally required for cost keeping purposes are:

1. Daily time ticket.
2. Payroll sheet.

1. *Daily Time Tickets*—The time tickets should be used to report the time spent on the various kinds of work performed. Only one job, either direct or indirect, should be on one time ticket. This is so that the time ticket may be filed under its order number, whereby the actual original entry becomes our cost entry.

The time tickets should provide the following information: Order number, pattern number, name of operation or work performed, machine number on which work performed, quantity completed, piece or hourly rate, elapsed time, wages earned, man number, and date.

In keeping time it should and must be verified daily that the total time represented by the time tickets agrees absolutely with that shown by the in-and-out clock cards rung by each man, which usually are the regular weekly cards.

The daily time tickets are filed by order numbers after entry on payroll as described immediately following:

2. *Pay Roll Sheet*—The pay roll sheet, a weekly sheet for each man, should perform two functions:

First:—Collate the pay of each man for week.

Second:—So enter the time cards, that a controlling distribution is made as between direct and indirect labor for the purpose of

(a) In the case of direct labor, give us the amount for each department as the basis of our journal entry, and

(b) In the case of indirect labor to give us a total which *must be equalled* by the total of the indirect labor in the various monthly expense and burden statements as explained later, and which will complete the journal entry of the distribution of labor.

The payroll sheet, therefore, should be so arranged as to have columns approximately as follows:

Day of month
Slip number
Order Number
Direct labor (main heading)
Hours
Amount
Indirect labor (main heading)
Hours
Amount
Total (main heading)
Hours
Amount

Additions of bonus, etc., or deductions of any nature will be made at close of week at bottom of sheet.

It is important to fully understand at this point that direct labor is only that which may be *directly* charged to the product being manufactured—such as molding and coremaking labor. In some large foundries, especially steel, the finishing operations of chipping, grinding and the like better may be handled as direct labor, but never where only one part of it can be charged directly to the product. Melting and annealing labor and the like are only chargeable to the product through a pound or percentage method; therefore, this class of labor can only be classed as indirect labor.

Labor Distribution

As stated before, the distribution as between direct and indirect becomes our most valuable control of further entries. The making up of the expense and cost accounts described in Section III depends on the totals as shown herewith for proof of accuracy.

There being a pay roll sheet for each man for week we have three points to handle to arrive at our proper results:

First:—To arrive at total plant pay roll, add by adding machine (or draw off on recap sheet) for the week:
(a) Total direct labor.
(b) Total indirect labor.
(c) Total pay for week.
This should be done by producing departments (melting, molding, core, etc.). This gives us the direct labor for the departments where same applies for the week covered by the pay roll.

Second:—Where a week straddles the end of a month, the pay roll sheet of each man has to be sub-totaled or split, in order to arrive at the actual earned pay roll for the days belonging in each separate month.

Third:—The totals of direct, indirect and total pay for each week and portion of week, for each given month must be recapped, which then gives us the monthly totals of each, separated into each producing department.

We now have our control figures of direct, indirect and total earnings for the month. The total direct for each department is our basis for transfer from pay roll account to work in process, and also the basis for crediting the operating burden accounts with the proper amount of burden for each department at the predetermined rates used, charging work in process. (See journal entries.)

Section III
Expense Routine

EXPENSE accounting deals with those disbursements which contribute to and are necessary in connection with the production of salable merchandise but which are not apparent or directly traceable in finished product; includes labor performed not directly traceable on the finished articles; includes expense materials consumed in the processes of production; includes all expenditures for maintenance of property, buildings and equipment; also small tools and supplies, insurance, taxes, depreciation, power, heat and light.

On account of the fact that the indirect costs are applicable to the cost of the product in various ways, a brief explanation of same is here made:

Melting Cost is distributed on the basis of cost per pound of metal poured. It is evident that the quantity of metal used in pouring a mold, including the casting itself and all sprue is the correct basis of the charge—at the pound rate—to that casting.

Molding Burden-Direct Labor is distributed by percentage on the direct molding labor, this being the most generally accepted manner of distributing this expense.

Molding Burden-Machine Hour is distributed on the basis of predetermined cost per hour, it being the natural method to charge for the use of machine equipment on the basis of the time it is used.

Core Burden-Direct Labor is on same basis as molding except, of course, being on direct coremaking labor.

Core Burden-Machine Hour—Same idea as in molding.

Molding Sand Expense (if used separately from being a part of molding burden) is distributed on the basis of metal poured. This is on account of the fact that the contact of metal is the regulating factor of destruction of sand, therefore total poured is the basis.

Flask Expense (if used) is on the basis of cost per pound of good castings produced.

Finishing Cost is distributed on basis of molding and core direct labor combined for the reason that molding direct labor represents the "outside" and the core direct labor the "inside" work necessary to properly clean the casting. This therefore, allocates greater finishing expense to cored castings as is proper.

Annealing Cost is distributed on basis of good castings, as there is the existing record of such basis. However, if one will, the even more correct basis should be that of castings actually annealed, although the basis of good castings is near enough correct in the majority of cases.

The preceding appear in the compilation of any casting or class plant cost. The following are expenses which, after being collected are apportioned or split down to the operating expense accounts.

Apportioned Expenses

Power, Light and Heat Expense is apportioned to the various operating expense and burden accounts on the best basis possible as representing the actual benefit received by each department. Metered consumption is of course best; estimates on basis of horsepower of motors, wattage of lamps for light charges, floor space for heating, etc., are next best, and the usual way.

Pattern Expenses are apportioned to the molding and core burden accounts on the basis of actual benefits received as explained in the detail directions.

General Expense is apportioned to the operating expense and burden accounts on the basis of the total labor cost, direct and indirect, of each operating department. For instance, the total direct labor plus the total indirect labor charged to expense orders in the molding department would be its basis; i. e., such a per cent of the general expense as its cost is of the total of all the departments.

Miscellaneous Items are apportioned to the operating expense and burden accounts according to the nature of the item—See under Group 8 following.

All possible expense should be charged directly to one of the operating expense or burden accounts. Where impossible the general expense, power, light and heat expense, etc., are to be used.

The items entering into each of the operating expense and burden accounts, and into the general accounts are clearly shown in the following pages. All charges come from time tickets, requisitions, etc., all of which must bear the expense code order number to which they belong.

Certain charges which are best made directly from the entry of a purchase are handled by the *expense ledger charge slip*, which shows date, account charged, amount of charge, date of invoice and description of what is charged. An invoice for such material is charged in the purchase register to *expense ledger account*, showing therewith the proper expense order number. An expense ledger charge slip is made out at the same time, which slip is the size of the material requisition. This slip is sent to the cost department, who file it with proper order number same as is done with a requisition. When costs are figured for month, the total of the expense ledger charge slips appearing in the various cost statements *must equal* the total of the expense ledger column in the purchase register for the same month. This is explained further under *Cost Compilation*.

If any foundry installing their methods are only a unit of a larger business, some method will necessarily be required to get charges for service to the foundry accounts in a manner to be checked up in some such manner as if the foundry department were a separate business.

Expense and Burden Accounts

In order to have an analysis of what makes up each expense and burden account for purpose of constant check on the expenditures of money, there follows a set of analytical expense orders, grouped in the necessary divisions or cost figuring.

The items shown may be changed to suit any plant; may be increased or de-

creased in number; but under no circumstances should any foundry attempt to do business without a fairly complete analysis along the lines shown.

These expenses are grouped as has been previously shown, but for reference are as follows:

Group 1—Melting Cost; Group 2—Molding Burden—Direct Labor; Group 3—Molding Burden—Machine Hour; Group 4—Core Burden—Direct Labor; Group 5—Core Burden—Machine Hour; Group 6—Finishing Cost; Group 7—Annealing Cost; Group 8—Apportioned Expenses: (a) Power, light and heat, (b) Pattern expenses, (c) General expense, (d) Miscellaneous items; Group 9—Administrative Expense; Group 10—Selling Expense.

LABOR MELTING EXPENSES GROUP 1

101—FOREMEN AND ASSISTANTS.
All amounts paid for services of general or supervising foreman.

102—TIMEKEEPERS AND OTHER CLERKS.
Salaries or wages of timekeepers or other clerks located in this department; includes, also, pro-rata amount of salaries or wages paid to time keepers or other clerks serving this and another department.

103—UNLOADING MELTING MATERIALS.
Wages paid for unloading cars or boats containing melting materials if a short term or normal supply. If exceptional quantities are obtained for long term storage, the labor expense should be added to the invoice cost as are freight charges and disbursements charged accordingly.

104—CUPOLA OR FURNACE LOADERS.
Wages paid men for loading cupolas and oil furnaces and open-hearth steel furnaces, also melters at small pots for making crucible steel.

105—ELEVATOR AND CRANEMEN.
Wages paid for operating elevators and cranes in connection with handling melting materials.

106—BREAKING SCRAP.
Wages paid for breaking up scrap or otherwise preparing scrap for use in cupola or furnace

107—HANDLING SLAG
Wages paid for handling and removal of slag, collecting over-iron, shot, spills, etc.

108—TESTING MATERIALS AND PRODUCT.
All amounts paid laboratory employes engaged in analysis and test of melting materials and foundry product.

109—MELTING MATERIALS STORES LABOR.
Wages of men engaged in moving melting materials from storage areas to charging platform, excepting services of elevator and crane men

110—SICKNESS AND ACCIDENT RELIEF.
Wages paid to employes absent on account of sickness or accident. Allowance must be approved by Superintendent.

111—GENERAL LABOR
Wages paid to miscellaneous general labor not provided for in this classification.

112 ....
113—..

MAINTENANCE OF PROPERTY

121—BUILDINGS.
Labor and material used in repairing or partially renewing buildings or structures

122—CUPOLAS OR FURNACES.
Labor and material used in repairing or partially renewing cupolas and furnaces, also their equipment for draft and circulation of air, as well as foundations.

123—CONVERTERS.
Labor and material used in repairing or partially renewing converters.

124—ELEVATORS, CRANES AND CONVEYORS.
Labor and material used in repairing or partially renewing elevators, cranes, conveyors, transfer tables, etc.

125—ELECTRICAL APPARATUS.
Labor and material used in repairing or partially renewing all electrical apparatus.

126—PIPE AND POWER LINES.
Labor and material used in repairing or partially renewing all piping, plumbing and electrical wiring inside of buildings, including drainage and sewer pipes, water, gas, air and oil pipes and their fittings; cables and wires for power and lighting circuits, including wiring devices.

127—PLATFORM AND STAIRWAYS.
Labor and material used in repairing or partially renewing charging platform and stairway.

128 ....
129—..
130—..

SUPPLIES

141—ALUMINUM
142—BRICK.
143—CLAY.
144—COKE.
145—ELECTRODES
146—FUEL OIL.
147 LIME.
148—LIMESTONE.
Self-explanatory

149—LINING MATERIALS
All miscellaneous lining materials used in the upkeep of ladles, stoppers, spouts, etc

150—SAND.
Self-explanatory.

151 MISCELLANEOUS SUPPLIES.
Miscellaneous materials not otherwise provided for in this classification.

152 LABORATORY EXPENSE.
Expenditures in connection with the laboratory other than salaries or wages which are chargeable to Account No. 108

153 ....
154—..
155—..

MOLDING BURDEN—DIRECT LABOR

201—FOREMEN AND ASSISTANTS.
All amounts paid for services of general or supervising foremen.

202 TIMEKEEPERS AND OTHER CLERKS.
Salaries or wages of timekeepers or other clerks located in this department; includes, also pro-rata amount of salaries paid to timekeepers or other clerks serving this and another department.

203 CUTTING SAND AND PREPARING FLOORS.
Wages paid for cutting sand and otherwise preparing the floors for molders.

204 CLOSING AND CLAMPING MOLDS.
Wages paid for all labor engaged in closing and clamping molds.

205—DRYING MOLDS.
Wages of men operating drying ovens in connection with dry-sand molding, both filling the ovens and drying the sand

206 RUNNER CUPS.
Wages of men engaged in making runner cups or boxes.

207 BROKEN MOLDS.
Wages of men engaged in repairing and finishing broken molds.

208 CARRYING PATTERNS AND FLASKS.
Wages of men engaged in carrying patterns and flasks to and from storage.

209 POURING.
Wages of men engaged in work of pouring

210—SHAKING OUT.
Wages of men engaged in shaking out castings

211—TAKING OUT REFUSE AND SCRAP.
Amounts paid for taking out and disposing of refuse and delivery of scrap

212 CLEANING AND SWEEPING.
Amounts paid for services in sweeping, raking or otherwise cleaning the department.

213—CRANE OPERATOR.
Wages paid for services of cranemen in the department operations.

214—IDLE TIME
Wages paid men for idle or unapplied time, and reason for the charge must always be given. Does not include allowances for sickness or accident.

215 SICKNESS AND ACCIDENT RELIEF.
Wages paid to employes absent on account of sickness or accident. Allowances must be approved by the Superintendent.

216—PATTERN STORAGE LABOR.
Wages of men engaged in receiving, storing and laying out patterns and core-boxes

217—EXPENSE DUE TO ERRORS AND DEFECTS.
Expenses or losses due to errors of department employes whether mechanical or clerical, as for example: breakage, spoilage, misplacement or careless shop work of any kind.

218—GENERAL LABOR.
Wages paid to miscellaneous general labor not provided for in this classification

219 ....
220 ....

MAINTENANCE AND SUPPLIES.

221—BUILDINGS.
Labor and material used in repairing or partially renewing buildings or structures.

222 MOLDING MACHINES. (Omit if Machine Rate used.)
Labor and materials used in repairing or partially renewing all molding machines other than jarring.

223—JARRING MACHINES. (Omit if Machine Rate used.)
Labor and material used in repairing or partially renewing all jarring machines.

224—AIR HOISTS.
Labor and material used in repairing or partially renewing all air hoists.

225—CRANES.
Labor and material used in repairing or partially renewing all cranes.

226—ELECTRICAL APPARTUS.
Labor and material used in repairing or partionally renewing all electrical apparatus.

227—SHOP FIXTURES.
Labor and material used in repairing or partially renewing all shop fixtures such as benches, racks, bins, lockers, railings, etc.

228 PIPE AND POWER LINES.
Labor and material used in repairing or partially renewing all piping, plumbing, and electric wiring inside of buildings, including drainage and sewer pipes, water, gas, air and oil pipes and their fittings; cables and wires for power and lighting circuits, including wiring devices.

229 SMALL TOOLS.
Labor and material used in repairing or partially renewing all small tools within the department which have a comparatively long term of usefulness; such as portable pneumatic rammers, chain hoists, screw or hydraulic jacks, hand trucks, chain and rope tackles, etc.

230—GAGGERS, CHILLS, CHAPLETS AND BOLTS.
231—NAILS.
232—LAMP BULBS

Names of supplies self-explanatory.

233—PATTERNS.
Labor and material used in the alteration and repair of patterns shall be accumulated under Account 702 and shall be transferred monthly to this account. Account 702 is a memorandum account only to be used as a basis in the apportionment of the Pattern Department expenses as described under account 702.

234—MOLDING SAND EXPENSE.
Expenses in connection with molding sand cost are such an important element in the operating of the Molding Department that provision is made herein for the directly traceable factors of molding sand cost which may be summarized as a separate schedule, if desirable, and so reported.

The following sub-accounts shall be used:

234—1 MOLDING SAND.
Cost of molding sand used during the month (i. e., invoice price plus transportation charges).

234—2 UNLOADING MOLDING SAND.
Wages paid for unloading cars or boats containing molding sand if a short term or normal supply. If exceptional quantities are obtained for long term shortage, the labor expense should be added to the invoice cost as are freight charges and disbursement charged accordingly.

234 3 MIXING MOLDING SAND.
Wages of men engaged in mixing molding sand including preparation and wheeling.

234 4 MAINTENANCE OF MIXERS.
Labor and material used in repairing or partially renewing sand mixers.

234—5 MISCELLANEOUS SUPPLIES.
All incidental and miscellaneous supplies not otherwise provided for in this classification.

234 6 MISCELLANEOUS EXPENSES.
All other incidental and miscellaneous disbursements not provided for in this classification.
Molding sand cost, if reported as a separate factor, should be liquidated at a cost per pound of metal poured, or, else, included in the departmental burden and those combined in the departmental percentage on direct labor.

235—FLASKS.
Expenses in connection with flask cost are also such an important element in the operating of the molding department that provision is made herein for the directly traceable factors of flask cost which may be summarized as a separate schedule, if desirable, and so reported. The following sub-accounts shall be used:

235—1 WOOD FLASKS AND BOTTOM BOARDS.
Labor and material used in making (unless for special orders) repairing or replacing wood flasks or bottom boards shall be accumulated under Account 704 and shall be transferred to this account. Account 704 is a memorandum account only to be used as a basis in the apportionment of the pattern department expenses as described under Account 704.

235—2 SNAP FLASKS AND JACKETS.
Labor and material used in repairing

or partially renewing snap flasks and making new or replacing old wood jackets shall be accumulated under Account 705 and shall be transferred to this account. Account 705 is a memorandum account only to be used as a basis in the apportionment of the pattern department expenses as described under Account 705.

235—3 METAL FLASKS.
Labor and material used in repairing or partially renewing all metal flasks.

235—4 FLASK PLATES.
Labor and material used in repairing or partially renewing all flask plates.

236—NONDURABLE TOOLS.
Cost of repairing and renewing all tools and equipment of a nondurable nature and classed as a miscellaneous shop supply. This account is intended to cover mainly those classes of portable tools which are short lived and comparatively inexpensive. All current expenditures for nondurable tools should be distributed to this account whether such expenditures represent initial cost of additions or replacements of the nondurable tool equipment.

237—METAL ARBORS AND CORES.
Labor and material used in repairing or partially renewing all metal arbors and cores.

238—MISCELLANEOUS SUPPLIES AND EXPENSES.
Incidental and miscellaneous disbursements not otherwise provided for in this classification.

239—...
240—...

MOLDING BURDEN—MACHINE HOUR GROUP 3.

251—MAINTENANCE OF MOLDING MACHINES
Labor and material used in repairing or partially renewing all molding machines other than jarring machines.

252—MAINTENANCE OF JARRING MACHINES.
Labor and material used in repairing jarring machines.

COREMAKING BURDEN—DIRECT LABOR

301—FOREMEN AND ASSISTANTS.
All amounts paid for services of general or supervising foremen.

302—TIMEKEEPERS AND OTHER CLERKS.
Salaries or wages of timekeepers or other clerks located in this department; includes also prorata amount of salaries or wages paid to timekeepers or other clerks serving this and another department.

303—INSPECTING CORES.
Wage of Inspectors engage in the inspection of cores.

304—UNLOADING CORE SAND.
Wages paid for unloading cars or boats containing core sand if a short term or normal supply. If exceptional quantities are obtained for long term storage the labor expense should be added to the invoice cost and freight charges and disbursement charged accordingly.

305—WHEELING AND MIXING CORE SAND.
Wages of men engaged in mixing core sand including preparation and wheeling.

306—UNLOADING AND TENDING OVENS.
Wages of men operating drying ovens in connection with baking cores, including firing the oven.

307—HANDLING CORES.
Wages of men engaged in handling cores to and from storage.

308—REPAIRING CORES.
Wages of men engaged in repairing defective cores.

309—CRANE OPERATOR.
Wages paid for services of cranemen in the department operations.

310—STORING CORES.
Wages of men engaged in receiving, storing and laying out cores.

311—SICKNESS AND ACCIDENT RELIEF.
Wages paid to employes absent on account of sickness or accident. Allowance must be approved by the Superintendent.

312—EXPENSE DUE TO ERRORS AND DEFECTS.
Expenses or losses due to errors of department employes whether mechanical or clerical, as for example: breakage, spoilage, misplacement or careless shop work of any kind.

313—GENERAL LABOR.
Wages paid to miscellaneous general labor not provided for in this classification.

314—...
315—...

MAINTENANCE AND SUPPLIES.

321—BUILDINGS.
Labor and material used in repairing or partially renewing buildings and structures.

322—COREMAKING MACHINES. (Omit if Machine Hour Rate Used.)
Labor and material used in repairing or partially renewing all coremaking machines.

323—SAND MIXING MACHINES.
Labor and material used in repairing or partially renewing core sand mixing machines.

324—ELECTRICAL APPARATUS.
Labor and material used in repairing or partially renewing all electrical apparatus.

325—CORE OVENS.
Labor and material used in repairing or partially renewing all core ovens.

326—SHOP FIXTURES.
Labor and material used in repairing or partially renewing all shop fixtures, such as benches, racks, bins, lockers, railings, etc.

327—PIPE AND POWER LINES.
Labor and material used in repairing, or partially renewing all piping, plumbing, and electric wiring inside of buildings, including drainage and sewer pipes, water, gas and oil pipes.

328—CRANES.
Labor and material used in repairing or partially renewing all cranes.

329—PLATES.
Labor and material used in repairing or partially renewing all core plates.

330—SMALL TOOLS.
Labor and material used in repairing or partially renewing all small tools within the department which have a comparatively long term of life.

331—CORE BOXES.
Labor and material used in the alteration and repair of core boxes shall be accumulated under account 703 and shall be transferred monthly to this account. Account 703 is a memorandum account only to be used as a basis in the apportionment of the Pattern Department expenses as described under account 703.

332—FUEL CONSUMED.
Includes the cost of all fuel used in the core ovens.

333—CORE SAND.
334—CLAY.
335—CORE COMPOUND AND OIL.
336—FLOUR.
337—SILICA WASH.
338—RODS, WIRES, NAILS.
Names of supplies—self-explanatory.

339—MISCELLANEOUS SUPPLIES AND EXPENSES.
All incidental and miscellaneous disbursements not provded for in this classification.

340—...
341—...

COREMAKING BURDEN—MACHINE HOUR GROUP 5.

351—MAINTENANCE OF COREMAKING MACHINES.
Labor and materials used in repairing coremaking machines.

LABOR. FINISHING COST GROUP 6.

401—FOREMEN AND ASSISTANTS.
All amounts paid for services of general or supervising foremen.

402—TIMEKEEPERS OR OTHER CLERKS.
Salaries or wages of timekeepers or other clerks located in this department; includes also, prorata amount of salaries or wages paid to timekeepers or other clerks serving this and another department.

403—INSPECTORS.
Wages of Inspectors engaged in departmental inspection work.

404—CRANE OPERATORS.
Wages paid for services of cranemen in the departmental operations.

405—HANDLING GOOD PRODUCT.
Wages for handling good product in finishing department and piling good castings in storage areas.

406—TAKING OUT REFUSE AND SCRAP.
Wages paid for collecting and disposing of refuse and scrap.

407—CLEANING AND SWEEPING.
All amounts paid for service in raking, sweeping or otherwise cleaning the department.

408—UNLOADING MISCELLANEOUS MATERIALS.
Wages paid men for unloading miscellaneous materials of short term supply excepting as otherwise provided for in this classification.

409—EXPENSES DUE TO ERRORS AND DEFECTS.
Expenses or losses due to errors of department employes whether mechanical or clerical, as for example; breakage, spoilage, misplacement or careless shop work of any kind.

410—SICKNESS AND ACCIDENT RELIEF.
Wages paid to employes absent on account of sickness or accident. Allowances must be approved by the Superintendent.

411—GENERAL LABOR.
Wages paid to miscellaneous general labor not provided for in this classification.

412—SHIPPING EXPENSE LABOR.
Wages paid shipping department helpers and laborers wherever located.

413—...
414—...

MAINTENANCE AND SUPPLIES.

421—BUILDINGS.
Labor and material used in repairing or partially renewing buildings or structures.

422—TUMBLERS.
Labor and material used in repairing or partially renewing all tumbling barrels or rolling mills.

423—GRINDERS.
Labor and material used in repairing or partially renewing all grinders. Does not include grind stones or emery wheels.

424—MACHINERY.
Labor and material used in repairing or partially renewing all transmission machinery within the department.

425—AIR TOOLS.
Labor and material used in repairing or partially renewing all air tools and connections used in the department.

426—CRANES.
Labor and material used in repairing or partially renewing all cranes, chain hoists and mechanical conveyors used in the department.

427—ELECTRICAL APPARATUS.
Labor and material used in repairing or partially renewing all electrical apparatus.

428—SAND BLAST APPARATUS.
Labor and material used in repairing or partially renewing sand blast apparatus.

429—CUTTING AND WELDING EQUIPMENT.
Labor and material used in repairing or partially renewing all cutting and welding equipment.

430—SHOP FIXTURES.
Labor and material used in repairing or partially renewing all shop fixtures, such as benches, racks, bins, lockers, railings, etc.

431—PIPE AND POWER LINES.
Labor and material used in repairing or partially renewing all piping, plumbing and electric wiring inside of buildings, including drainage and sewer pipes, water, gas, air and oil pipes and their fittings; cables and wires for power and lighting circuits, including wiring devices.

432—OTHER EQUIPMENT.
Labor and material used in repairing or partially renewing all other equipment not provided for in this classification.

433—SAND FOR SAND BLAST.
Cost of sand used in sand blasting during the month (i. e., invoice price plus transportation charges).

434—NONDURABLE TOOLS.
Cost of repairing and renewing all tools and equipment of a nondurable nature, excepting emery wheels, not classed as a miscellaneous shop supply. This account is intended to cover mainly those classes of portable tools which are short lived and comparatively inexpensive. All current expenditures for nondurable tools should be distributed to this account whether such expenditures represent initial cost of additions or replacement of the nondurable tool equipment.

435—ELECTRIC LAMPS.
Expense in connection with lamp globes, carbons and bulbs.

436—EMERY WHEELS.
Expense of emery wheels used in the finishing department. This account is used to exclude the expenses of emery wheels from Account 434, Nondurable Tools.

437—CARBIDE, HYDROGEN AND OXYGEN.
Cost of carbide, hydrogen and oxygen used during the month in cutting and welding processes.

438—WELDING MATERIAL.
Cost of all welding supplies such as metal sticks or wire, flux, etc.

439—SHIPPING EXPENSE MATERIALS.
Cost of all miscellaneous materials used in connection with shipping expense operations.

440—INSPECTION EXPENSE.
All incidental and miscellaneous expenditures (excepting labor) in connection with inspection of the company's product.

441—OTHER MATERIALS AND EXPENSES.
All incidental and miscellaneous disbursements not otherwise provided for in this classification.

442—...
443—...

ANNEALING COST. GROUP 7

501—FOREMEN.
All amounts paid for services of foremen.

502—OVEN TENDERS.
Wages of men operating annealing ovens including firing.

503—PACKING LABOR.
Wages paid for packing castings in annealing boxes or pots, or loading annealing cars.

504—PACKING MATERIALS.
Cost of packing materials used in annealing pots or boxes.

505—EXPENSES DUE TO ERRORS AND DEFECTS.
Expenses or losses due to errors of department employes whether mechanical or clerical, as for example, breakage, spoilage, misplacement or careless shop work of any kind.

506—BOXES.
Cost of annealing boxes used during the mouth.

507—FUEL CONSUMED.
Cost of all fuel used in the annealing ovens.

508—MAINTENANCE OF OVENS.
Labor and material used in repairing or partially renewing all annealing ovens.

509—MAINTENANCE OF ELECTRICAL APPARATUS.
Labor and material used in repairing or partially renewing all electrical apparatus.

510—MAINTENACE OF BUILDINGS.
Labor and material used in repairing or partially renewing buildings or structures.

511—MAINTENANCE OF MISCELLANEOUS EQUIPMENT.
Labor and material used in repairing or partially renewing all other equipment not provided for in this classification.

512—SHEET IRON USED IN MUFFLE FURNACES.
Cost of all sheet iron used in muffle furnaces.

513—MISCELLANEOUS SUPPLIES.
Cost of all miscellaneous supplies (other than enumerated above) consumed in the current operations of the annealing departments.

514—..
515—..

APPORTIONED EXPENSES GROUP 8.

1—POWER, HEAT AND LIGHT. (See detail 8a.)
Includes total of Group (8a) Power, Heat and Light Expenses, which amount shall be distributed on the proportionate basis of—

(a) **Power:** On the estimated used horsepower of motors installed in each department, to the total horsepower used in all departments.

(b) **Heat:** On the ratio of the floor space of each department heated to the total floor space of all departments heated.

(c) **Light:** On the wattage of lamps installed in each department to the total wattage installed in all departments.

2—PATTERN EXPENSES. (See detail 8b.)
Includes total of Group 8b Pattern Expenses, which amount shall be distributed against The Molding and Coremaking departments on the established proportionate basis of the benefits derived by each.

3—GENERAL EXPENSES. (See detail 8c)
Includes total of Group 8c General Expenses, which amount shall be distributed to the following accounts: (a) cost of melt: (b) molding burden; (c) coremaking burden; (d) finishing cost; and (e) annealing cost, on a percentage basis equivalent to total labor cost direct and indirect in the respective departments.

4—BONUS.
(a) **Attendance:** Based on percentage of earnings during six consecutive days' full time attendance. Bonus to be distributed against department in which it is earned.

(b) **Quantity:** Based on quantity production weekly or monthly. Bonus to be distributed against department in which it is earned.

5—DEPRECIATION.
Represents a monthly charge equivalent to the lessening value of investments as represented by building, machinery, electrical apparatus, furniture and other permanent equipment, the charge being based on a standard rate of percentage of the ledger values of the investment accounts which shall be chargeable against the expenses of the various departments according to the value of the departmental investment.

6—INSURANCE.
(a) **Fire Insurance.**
Includes the cost of fire insurance premiums. Charges to this expense shall be credited to such an account as "Unexpired Insurance" and be distributed monthly against the various departments on the basis of value involved.

(b) **Group Life Insurance.**
Includes the cost of group life insurance premiums distributed monthly against the various expense groups (i. e., Groups 1 to 8 inclusive) based on the number of employes in each department.

(c) **Liability Insurance.**
Includes cost of all premiums on employers' liability insurance and is to be distributed monthly on a proportionate percentage of the payroll of each department.

7—TAXES.
Includes all payments for taxes and assessments on real estate and personal property used for manufacturing purposes, excepting water taxes. The estimated cost of taxes is to be credited to an account such as "Taxes Accrued" and charged in monthly proportions against the various departments on the basis of the ratio of taxable values in each department to the total taxable values in all departments.

POWER, HEAT AND LIGHT EXPENSES. GROUP 8-a.

601—POWER PLANT AND SUB-STATION LABOR.
All amounts paid for services of engineer, firemen, electrician, or other supervision and labor in connection with the power plant or sub-station.

602—MAINTENANCE OF POWER PLANT EQUIPMENT.
Labor and material used in repairing or partially renewing all power plant equipment excepting stationary boiler.

603—MAINTENANCE OF SUB-STATION EQUIPMENT.
Labor and materials used in repairing or partially renewing all sub-station equipment such as transformers, switchboard, general power lines and all other miscellaneous electrical apparatus used in distributing or measuring electrical current.

604—OILS AND WASTE.
Cost of all lubricating oils, greases and waste.

605—ELECTRIC LAMPS.
Expenses in connection with lamp globes, carbons and bulbs.

606—FUEL CONSUMED.
Cost of coal or other fuel actually consumed based on periodical reports of consumption.

607—MAINTENANCE OF POWER PLANT BUILDINGS.
Labor and material used in repairing or partially renewing all power plant buildings and structures.

608—MAINTENANCE OF BOILER AND EQUIPMENT.
Labor and material used in repairing or partially renewing stationary steam boilers or other apparatus used in connection with the generation or distribution of steam, as injectors, draft system, pipes and fittings, water pumps, etc.

609—CURRENT PURCHASED.
Cost of all electric current purchased for either power or light.

610—MISCELLANEOUS EXPENSES.
Miscellaneous expenses not otherwise provided for in this classification.

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612..

Note No. 1—If compressed air is used in quantity and is supplied from a central station, it is recommended that a separate group expense be used like the "Power, Light and Heat" and handled in same way.

In many plants, however, a compressor is in each department where used, which of course would simply throw it in the expense account of the department.

In larger plants, however, a separate account should be used in similar manner to Power, Light and Heat.

Note No. 2—In large plants it is recommended to split Group 8-a, Power, Light and Heat, separating into an expense account for "Electric" and another for "Steam" expense. The same principles will govern and can easily be followed out.

PATTERN SHOP EXPENSES GROUP 8-b.

701—FOREMAN.
Wages for foreman for time spent in supervision. Does not include wages of working foreman which can be directly distributed against pattern orders, shop orders or other standing expense accounts.

702—ALTERATIONS AND REPAIRS TO PATTERNS.
Labor and material used in the alteration or repair of standard patterns owned by the company to suit the needs of the foundry. Does not include labor and material used in the alteration or repair of patterns which are customers' property; does not include labor and material used in making new patterns which are chargeable to customers or an investment account.
The total amount charged to this account shall be deducted from pattern shop expenses and transferred to Account 233, Patterns, together with a proportion of the residual pattern shop expenses after values in Accounts 702, 703, 704 and 705 have been deducted from charges to this expense group. The proportion shall be based on a percentage basis of the ratio of the value in Account 702 to the total of the values in Accounts 702, 703, 704, 705.

703—ALTERATIONS AND REPAIRS TO CORE BOXES.
Labor and material used in the alterations or repair of standard core boxes owned by the company to suit the needs of the foundry. Does not include labor and material used in the alteration or repair of core boxes which are customers' property; does not include labor and material used in making new core boxes which are chargeable to customers or an investment account.
The total amount charged to this account shall be deducted from pattern shop expenses and transferred to Account 331, Core Boxes, together with a proportion of the residual pattern shop expenses after values in Accounts 702, 703, 704 and 705 have been deducted from charges to this expense group. The proportion shall be based on a percentage basis of the ratio of the value in Account 703 to the total of the values in Accounts 702, 703, 704, 705.

704—MAKING NEW OR REPLACING OLD WOOD FLASKS.
Labor and material used in making new, repairing or replacing old wood flasks or bottom boards.
The total amount charged to this account shall be deducted from pattern shop expenses and transferred to Account 235-1, wood flasks and bottom boards, together with a proportion of the residual pattern shop expenses after values in Accounts 702, 703, 704 and 705 have been deducted from charges to this expense group. The proportion shall be based on a percentage basis of the ratio of the value in Account 704 to the total values in Accounts 702, 703, 704, 705.

705—MAINTENANCE OF SNAP FLASKS.
Labor and material used in repairing or partially renewing snap flasks and making new or replacing old wood jackets.
The total amount charged to this account shall be deducted from pattern shop expenses and transferred to Account 235-2, snap flasks and jackets, together with a proportion of the residual pattern shop expenses after values in Accounts 702, 703, 704 and 705 have been deducted from charges to this expense group. The proportion shall be based on a percentage basis of the ratio of the value in Account 705 to the total values in Accounts 702, 703, 704, 705.

706—MAINTENANCE OF BUILDINGS.
Labor and material used in repairing or partially renewing buildings or structures.

707—MAINTENANCE OF MACHINERY.
Labor and material used in repairing or partially renewing all machinery in pattern shop.

708—MAINTENANCE OF SHOP FIXTURES.
Labor and material used in repairing or partially renewing all shop fixtures, such as benches racks, bins, lockers, railings, etc.

709—MISCELLANEOUS LUMBER.
Cost of all lumber for miscellaneous purposes, not provided for in this classification. All charges possible should be made against Accounts 702 to 705 inclusive.

710—NONDURABLE TOOLS.
Cost of repairing and renewing all tools and equipment of a nondurable nature. This amount is intended to cover mainly those classes of portable tools which are shortlived and comparatively inexpensive. All current expenditures for nondurable tools should be distributed to this account whether such expenditures represent initial cost of additions or replacement of the nondurable tool equipment.

711—MISCELLANEOUS SUPPLIES AND EXPENSES.
Miscellaneous disbursements not otherwise provided for in this classification.

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GENERAL EXPENSES. GROUP 8-c.

801—SALARIES—DEPARTMENT HEADS.
Salaries of managers, general superintendents and those having supervision over a regularly established general department. (Not a producing department.)

802—SALARIES—CLERICAL.
Salaries and wages of all office clerks not directly distributable to a departmental expense account.

803—YARD LABOR.
Wages paid men engaged in general yard labor not distributed to other accounts provided herein.

804—GENERAL LABOR.
Wages paid men engaged in unclassified work not distributed to other accounts in this classification.

805—GENERAL REPAIR MEN.
Wages only of employes in the maintenance department which are not distributable directly to specific accounts as provided for in this expense classification.

806—SICKNESS AND ACCIDENT RELIEF.
Wages paid to employes absent on account of sickness or accident, which are not chargeable to operating departments. Allowances must be approved by the Superintendent.

807—PRINTING AND STATIONERY.
Cost of all printed forms and stationery used during the month by plant departments.

808—OFFICE SUPPLIES.
Cost of all minor office supplies and conveniences used by plant offices.

809—TRAVELING EXPENSES.
All payments for transportation, hotel and other necessary expenses in connection with foundry requirements other than administrative and selling.

810—TELEPHONE AND TELEGRAPH.
Expense of all local and long distance public telephone service, the rental of interior service and a proportion of wages of the switchboard operator based on services performed. Includes expense of telegraphing. All the preceding applies to Plant Operations.

811—CAR DEMURRAGE.
All amounts paid as demurrage for detention of cars belonging to railroad companies.

812—GENERAL STORES EXPENSE.
Wages of storekeeper and assistants engaged in the receiving, storing and delivery of general stores. This account also includes office supplies and stationery used in connection with the above function.

813—WATCHMEN'S EXPENSE.
Wages paid watchmen and other miscellaneous expenditures in connection with watchmen's service.

814—BLACKSMITH SHOP EXPENSES.
All expenditures in connection with the blacksmith shop not distributable directly to some other account. Includes labor and material and all pro-rations applicable to the blacksmith shop.

815—REPAIR DEPARTMENT EXPENSES.
All expenditures in connection with the repair or maintenance department not distributable directly to some other account. Includes labor and material and all prorations applicable to the repair department.

816—TRUCKING OR TEAMING EXPENSES.
All expenditures in connection with garage and automobile service, stable and cartage service and all payments for all miscellaneous and unassignable hired cartage of material and supplies, both incoming and outgoing.

817—MAINTENANCE OF OFFICE BUILDING.
All labor and material used in repairing or partially renewing office building.

818—MAINTENANCE OF BUILDINGS AND EQUIPMENT. (GENERAL.)
All labor and material used in repairing or partially renewing buildings and equipment when such charges cannot be distributed against a particular department as provided for in this classification.

819—MAINTENANCE OF YARDS, FENCES AND GROUNDS.
All labor and material used in repairing or partially renewing all roadways, sidewalks, fences, regrading of yards, maintaining lawns and all tools and implements used exclusively in connection therewith.

820—MAINTENANCE OF TRACKS.
All labor and material used in repairing or partially renewing all railway tracks in yards and shops, including turntables and tracks on trestles.

821—REPAIRS ON RETURNED MATERIAL.
Wages paid for reclaiming processes on returned material to restore such material to salable condition if defect is not directly traceable to an operating department.

822—MISCELLANEOUS EXPENSES.
Miscellaneous disbursements not otherwise provided for in this classification.

ADMINISTRATIVE EXPENSES. GROUP 9.

1001—EXECUTIVES' SALARIES.
Compensation of corporate and general executive officers. Executive officers engaged in sales work should be charged directly to Account No. 1101—Salaries, under Group 10, Selling Expenses.

1002—OFFICE SALARIES.
Salaries of all clerks, including stenographers, reporting directly to the executive officers.

1003—OFFICE SUPPLIES AND EXPENSES.
Cost of all stationery, printed forms, office supplies and miscellaneous expenditures made in connection with executive offices.

1004—TRAVELING EXPENSES.
Payments for transportation, hotel and other necessary expenses, including entertaining incurred by executive officers.

1005—ASSOCIATION DUES.
Membership fees in trade or manufacturing associations.

1006—CHARITIES.
Cost of all voluntary subscriptions to hospitals or other local charity organizations.

1007—MISCELLANEOUS EXPENSES.
Miscellaneous disbursements not otherwise provided for in this classification.

SELLING EXPENSES. GROUP 10.

1101—SALARIES.
Salaries of sales manager, sales department representatives and clerks.

1102—COMMISSIONS.
All amounts accrued as commissions to salesmen based on sales billed (or orders taken) during the month.

1103—TRAVELING EXPENSES.
All payments for transportation, hotel and other necessary expenses including entertaining, incurred by sales department representatives.

1104—OFFICE SUPPLIES AND EXPENSES.
Cost of all stationery, printed forms, office supplies used, and miscellaneous expenditures made in connection with the sales department.

1105—ADVERTISING.
Cost of all catalogs, price lists, stock lists, and all other printed matter intended to be of sales assistance. Includes payment for advertisements descriptive of the company's business or product inserted in newspapers, magazines, trade publications, etc., also cuts, electros, etc., used in connection therewith. Includes cost of samples for use of salesmen.

1106—TELEPHONE AND TELEGRAPH.
Local and long distance public telephone service, the rental of interior service, and a proportion of the wages of the switchboard operator based on services performed. Includes expense of telegraphing.

1107—POSTAGE.
Self-explanatory.

1108—MISCELLANEOUS EXPENSES.
Miscellaneous disbursements not otherwise provided for in this classification.

Section IV
Production Routine

ALL castings made should be authorized by a casting production order which should be in sufficient copies to notify the various departments interested of the exact requirements involved and to prevent over-fulfillment of requirements. The order should show clearly the order number or class number chargeable, in order that the application of cost may be dependable. A work-in-process record by pattern numbers should be maintained showing the order number and number of castings ordered and completed, as well as dates of the transactions. Dependable reports should be made showing the number of castings made daily, good and defective, and the corresponding weights by order or class number and pattern numbers.

Book Review

Metallography; by Samuel L. Hoyt, metallurgical engineer, National Lamp Works, General Electric Co., and formerly associate professor of metallography, the University of Minnesota; cloth; 6 x 9 inches; published by McGraw-Hill Book Co., Inc., New York, and furnished by THE FOUNDRY for $3 net.

An exhaustive and comprehensive work on the science and application of metallography. The subject has been divided into three parts by the author: Part I, *Principles of Metallography*, a book of 251 pages, is now ready for distribution. Part II, *The Metals and Common Alloys*, is on the press. Part III, *Technical Practice*, is in preparation. The first book is the outgrowth of a lecture course given at the University of Minnesota to students specializing in metallography. It deals with the general principles of the science and with some of the more important methods which are used to carry out general investigations in the metallographic laboratory. Parts 2 and 3 will deal with the metallography of the more important metals and alloys, including steel, cast iron and special steels and the application of metallography to the metallurgical and engineering industries. In the first volume, general principles are discussed in seven chapters and under numerous subheads.

Takes Over Lynchburg Plants

The James River Foundry Co. and the C. W. Hicks Machine Works have been taken over by the Southern Electro Steel Co., Inc., Lynchburg, Va. In addition, the company is having plans prepared for a modern electric steel foundry. The former owners of the firms taken over, William Farmer and C. W. Hicks, have been retained by the purchasing company to act as superintendents in the respective plants.

Foundry Company Incorporated

The Gold Coin Stove & Foundry Co., 26 DeWitt street, Albany, N. Y., recently was incorporated to take over the present plant of the Gold Coin Stove & Foundry Co., 16-22 DeWitt street. Announcement concerning election of officers will be made later, but it already has determined to build a new foundry, equipped with modern appliances.

Exports Tire Molds

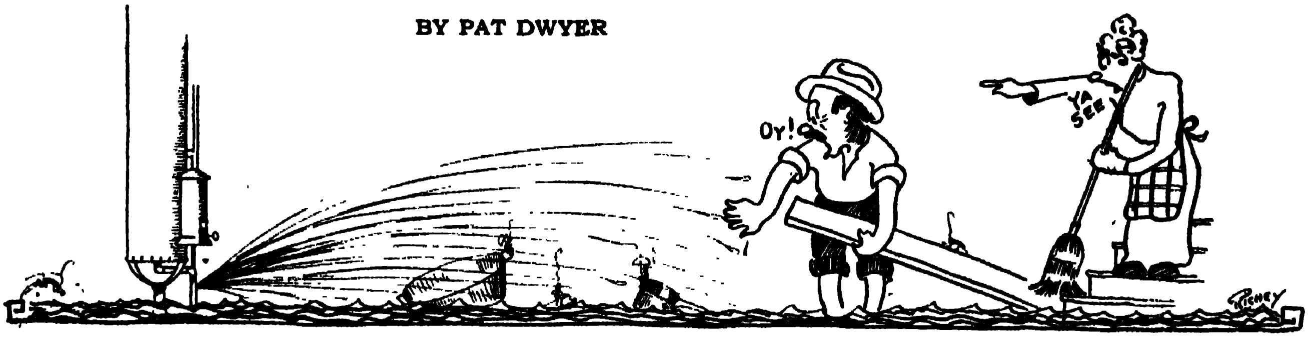
Export of the products of the tire mold division of the Wilson Foundry & Machine Co., Pontiac, Mich., recently was initiated by the shipment of 12 tire molds and 150 tire cores to the Dunlop Rubber Co., Aston, England. Special heavy crates were prepared for the initial consignment to England, which comprised 87 crates, the total weight being over 30 tons.

Will Manufacture Axles

The United States Axle Co. has been organized at Pottstown, Pa., to take over the plant of the Industrial Foundry & Machine Co., of that city. The new company will install additional machinery for the manufacture of axles for motor vehicles. The officers are: President, George C. Lee, Pottstown; vice president, D. L. Britton; secretary-treasurer, L. E. Orgill. In addition to the officers, the board of directors is comprised of H. C. Lang, New York, and Dwight R. Heigs, of Pottstown, Pa.

Bill Comments on Blast Furnace Coolers

BY PAT DWYER

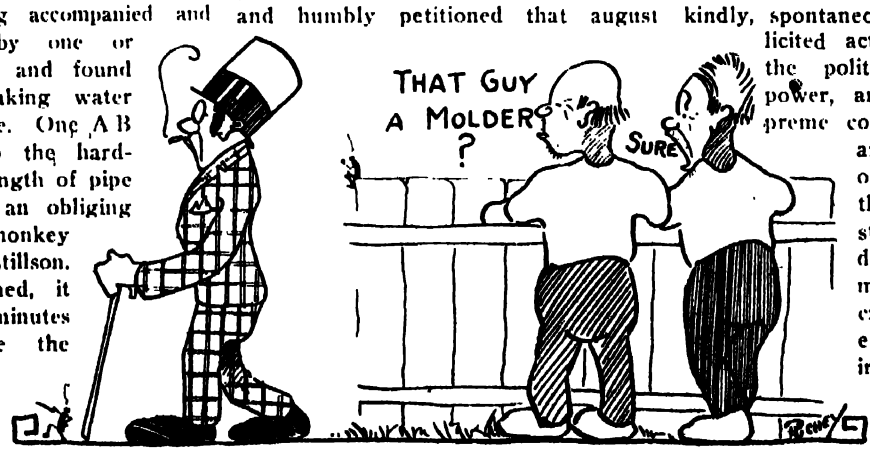


HAVING finished the arduous duties of the day as one of the cogs of the wheel of industry, I removed the grime from my person, put on my coat and after contributing a nickel to help swell the coffers of the corporation which controls the traction rights in the city, I found myself a half an hour later entering the front door of the house which I am buying in monthly installments—for another man. Before I had time to call the roll or even see what was spread on the frugal board, I was told by the Chief of the Bureau of Domestic Relations that one of the hot water connections on the boiler in the cellar was broken and she was afraid it would be necessary to take to the boats be fore morning. I consoled her by remarking that if there was anything left after we had eaten, we would provision the long boat and then it would make no difference to us whether the ship went down or not, as we did not own her. With the peculiar inconsistency of her sex, she could not see it that way and insisted that I go down at once and fix the leak. I remonstrated gently, but firmly withall, that if I were going to drown I preferred to do it comfortably on a full stomach and without a collar.

After the meal I went down into the fore-hold being accompanied and escorted thither by one or two trusty A Bs and found that she was making water through a split pipe. One A B was dispatched to the hardware store for a length of pipe and the other to an obliging neighbor for a monkey wrench and a stillson. When they returned, it was only a few minutes work to remove the broken piece, insert the new one and connect her up again. We turned on the water and were engaged in contemplating the masterpiece when Bill appeared at the hatchway and sang out: "Ship ahoy! Do you want a tow line?" I told him that I thought we could make port under our own steam and asked him to come down if he wanted to see a classy piece of deep sea engineering He did so and after having given the job his unqualified approval he said: "This here pipe-fitting business is more important than some people think. I worked in a foundry at one time which turned out most of the castings for a neighboring steel works. The steel plant was a modest affair, in fact not much more than an infant in those days, comprising as it did a couple of open hearths, a forge, a guide mill and a cogging mill. 'Twas a strong, lusty infant though and in recent years has attained a stature which reflects credit on the men responsible for shaping its destinies. It also furnishes a theme for the local spellbinders when they wish to extoll the merits of a protective tariff as applied to the iron and steel industry in one of His Most Gracious Majesty's overseas dominions.

"Prompted solely by the most pure and patriotic motives, the owners of the plant in the early days made representations to those who sit in high places, to-wit, the government benches; and humbly petitioned that august body to enact certain measures which would encourage the manufacture of pig iron, at a reasonable profit to the petitioners. The paternal government lent its official ear kindly to the prayer of the petitioners and with many legal phrases like whereas and be it enacted, etc., had a statute, or a mandamus or an injunction, or whatever it is they call those things, entered upon the minutes to the effect that on and after a certain date, duly specified by the day, the month and the year of our Lord, contracted to A. D., and also the year of the reign of the aforesaid gracious sovereign, duly spelled out, a certain ad valorem duty would be collected by the duly authorized agents of the government on every ton or fractional part thereof of pig iron imported into the commonwealth. Furthermore, the government stood pledged to pay a bounty of $5 a ton on every ton or fractional part thereof of pig iron produced by any of its loyal and patriotic citizens in a domestic hearth, stack, or other suitable device constructed for the reduction of metallic iron from the ore, provided this device was erected on property within the bounds of the commonwealth, and the ore used was mined, quarried, blasted, dug or otherwise exhumed from land within its borders.

"Heartened and encouraged by this kindly, spontaneous and totally unsolicited action on the part of the political party then in power, and viewing with supreme contempt the dastardly and unpatriotic actions of the opposition in their attempts to strangle an infant industry and impede the march of progress and civilization—for as everyone knows, iron is the barometer of trade and the base of all commercial and industrial great-



THE MEMBERS OF THE OLD GUARD HAVE CAUSE TO BE SKEPTICAL

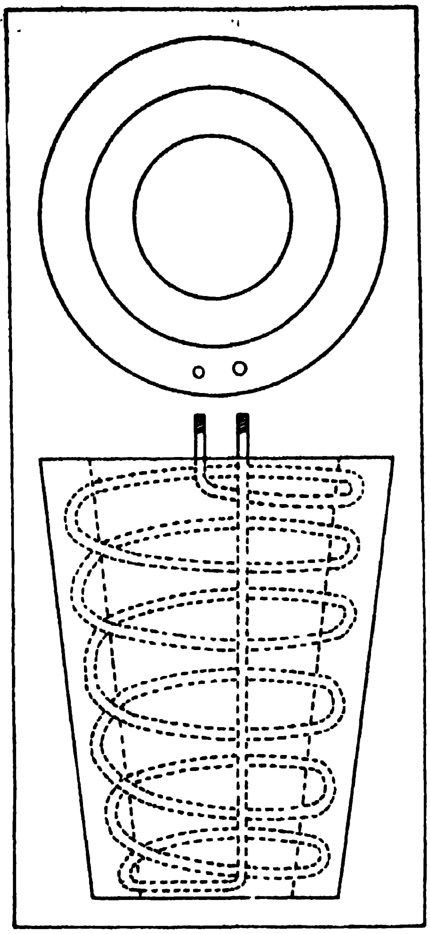
ness, the company proceeded to erect a blast furnace on a site which had been thoughtfully bonded some time before with a view of some such contingency arising. The mineral rights to a certain lot, piece or parcel of land also had been filed in the government archives.

"This was merely a precautionary measure taken to head off and checkmate the possible designs of any piratically minded people, who, when they heard of the industrial expansion about to be inaugurated, might have bonded the property and charged the party of the first part an exorbitant royalty on any minerals taken out, to the detriment of industry and to financial discomfiture of the aforesaid party of the first part.

"Having arranged all these preliminaries as became captains of industry, a blast furnace with all the necessary equipment, including a battery of coke ovens, was rushed to completion. The great day for blowing in at length arrived and the president's daughter, becomingly attired in a marvelous creation made for the occasion, stepped daintily forward and applied the torch.

"It was a great day, and as the local paper pointed out, inaugurated a new era of industry and ere long the stream which crept through the peaceful valley would reflect the lights from a hundred such furnaces and steel plants where as a natural consequence the town would proudly take its place with Sheffield, Pittsburgh and other great iron and steel producing centers of the world.

"Like many similar prophesies, this one was never realized. Owing to economic and political reasons, the company after a few years had elapsed erected a blast furnace and open-hearth plant close to a coal property which had been acquired. The original blast furnace was dismantled and moved to the new site. However what I started to tell you about occurred while the blast furnace still



THE COOLER FOR THE TUYERE OPENING IN A BLAST FURNACE IS PROVIDED WITH A COIL OF PIPE CAST IN

was in active operation in the embryo Pittsburgh.

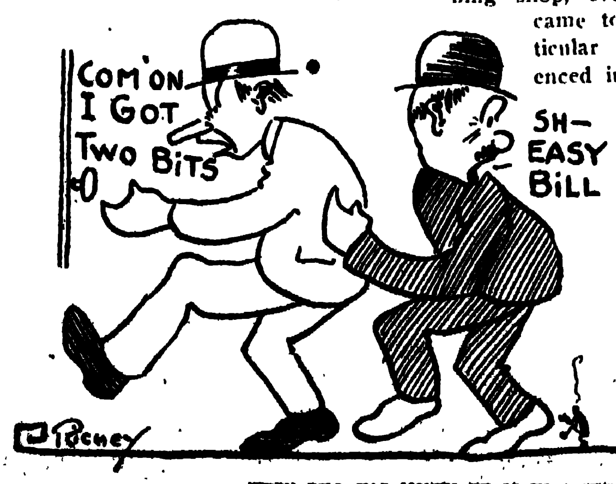
"As I said, we supplied nearly all the castings for the steel company and naturally after the furnace had been in blast for some time, we were called upon to make repair parts for items which had been burned or worn out. We had opportunity to make castings for practically everything around her, from the charging bell and hopper at the top of the stack to the blow pipes and cinder notch at the bottom. Being a strictly jobbing shop, everything was fish that came to our net and no particular difficulty was experienced in producing any of the castings required. The gaffer was a wise old bird even if he did wear side whiskers, supplemented on Sunday by a high hat. Of course, I am perfectly willing to admit that wearing a silk hat is not a crime and I will even go further and admit that I have seen men who looked good in them; a molder! Oh, boy!

"The only casting with which we had any trouble was that known as a *cooler*. You know what it is and for what it is used. It extends through the jacket and hearth wall of the furnace and forms a protection for the blow pipe and the tuyere. The number required of course depends on the size of the furnace. The size and general design of these castings also vary to some extent, but the main features are alike in them all. This old time cooler was about 2 feet long by 15 inches across the wide end, having a 4-inch thickness of metal and carrying a coil of 1-inch wrought-iron pipe, cast in.

"Molding the job was a simple operation, but when the old boy thought about casting it he was afflicted with the oldest disease known to man—cold feet. He never had had any experience with a casting of this particular character and consequently had no definite ideas of just what precautions would be necessary. The more he thought about it the more certain it seemed to him that the molten iron going into the mold would melt the thin wrought iron pipe and fill the coil with iron. If he had just gone ahead and treated the job as an ordinary part of the day's work, a course to which he was tempted by foundry tradition and training, all would have been well. Instead of that he was foolish enough to consult the foreman of the machine shop, who was the particular bright star in this plant. You know, one of those birds who knows everything.

"This lad solved the problem offhand Told the old man all he had to do was to run a stream of water through the coil while the metal was in a liquid state. Now of course the idea was all right, but like lots of other perfectly good ideas, it depended for its usefulness on being applied according to proper engineering principles. One important point which was overlooked in fitting up the water connection was that well known little law of physics which decrees that water expands when exposed to the action of heat, and when heated to a certain temperature is con-

(*Concluded on page* 419)



WHEN BILL HAS MONEY HE IS IN A HURRY AND HAS NO USE FOR THAT PUSSY-FOOT STUFF

THE FOUNDRY

A semimonthly journal devoted to all branches of the foundry trade

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Contents

Foundry Iron Shows Loss

PIG iron production for 1919 showed a marked decrease over that for the previous year. The total as reported by the American Iron and Steel institute was 31,015,364 tons or 20.58 per cent less than the 1919 total of 39,054,644 tons. The causes for this decrease in output are not remote to seek. Industrial disturbances and transportation difficulties took heavy toll. While the industries consuming pig iron did not get their stride until late in the year, the production may be said to be only a little short of consumption. Foundry iron and ferrosilicon which are classified together showed a loss of only 4.44 per cent with a 1919 total of 4,916,758 tons as compared with 5,145,260 tons for 1918. The loss in this case is directly chargeable to causes other than slack demand, for the foundry industry led off early in the summer of 1919 and before the first of the year recorded the greatest volume of business ever encountered in castings manufacture. At the beginning of this activity some blast furnaces making basic iron were converted to the manufacture of foundry grades, and although they again reverted to basic with the increase in demand for the latter product, the effect of the temporary change is evident in the total of foundry iron. Malleable pig iron showed a total 9.74 per cent less for 1919 than for 1918. The totals listed are 1,009,049 tons for last year as compared to 1,117,914 for the previous period. Malleable foundries, in general, did not get into heavy production as early as did the gray iron shops, but the use of malleable grades in foundries making automobile parts in a measure served to sustain the demand for this class of iron during the past year.

Slight Deviations Govern

FREQUENTLY when a foundry process is described some foundryman rises to remark that the thing cannot be done, because he has tried it in an identical manner and has failed. He may be right. His experience is to be trusted, if every minute detail in the method outlined, corresponds accurately with that which he tried. In foundry operations there are so many variables that one slight difference may determine the dividing line between success and failure. A striking example of the influence of minute details upon foundry procedure is illustrated in one instance by the variation in practice followed in adding manganese to iron. One melter adds it in the cupola while another insists that better results are secured when the manganese is added to the metal in the ladle. Both may be correct from their experience. The melter who secures the best results by placing the manganese in the ladle may have an oxidizing atmosphere in his cupola and burn out a large percentage of the manganese when he tries to add it in the cupola. A third melter may say that he secures no appreciable benefit by adding manganese to the iron *either* in the cupola or in the ladle. He, too, may be correct because he may melt an iron which has a low percentage of sulphur and a high percentage of silicon, or he may make castings which are not sensitive to slight changes in the metal. In either case the manganese effect would be minimized to a certain extent and any benefit secured might not be noticed.

Trade Outlook in the Foundry Industry

GLOOMY prospects confront foundries throughout the east and central west. The switchmen's strike, which seemed to be weakening two weeks ago is continuing to restrict shipments both of raw materials and finished products. Some plants are faced by the prospect of early discontinuance through lack of iron; others are out of sand; finished castings which cannot be shipped and paid for are piled in every available space in other foundries; and many have only a day-to-day supply of coke. Varied are the ways in which the transportation tieup operates, but the effect is the same, and unless early relief is effected, the greater portion of the castings industry will suffer severely.

East Is Hard Hit

In New England, the Delaware & Hudson railway affords the only channel for incoming freight, and this road recently has placed an embargo against the New York, New Haven & Hartford. The latter road will receive no pig iron at junction points outside of New ngland for delivery within the district. Providence foundries are consigning shipments to Worcester, Mass., and then reconsigning them to destination. Connecticut foundries are hard hit and several, including the W. & B. Douglas Co., Middletown, one of the oldest in the state, have been forced to close. The main trouble in New England is traceable to traffic congestion and embargoes rather than labor trouble in local yards. It is stated that if the present railway situation continues for two weeks more, fully 20 per cent of the New England foundries will be forced to close. While transportation of some classes of freight is improving through New York and New Jersey, but little pig iron is being received, and a serious shortage is imminent among foundries.

Prices of Raw Materials for Foundry Use

CORRECTED TO MAY 7

Iron

No. 2 Foundry, Valley	$43.25 to 44.25
No. 2 Southern, Birmingham	40.00 to 42.00
No. 2 Foundry, Chicago	43.00 to 45.00
No. 2 Foundry, Philadelphia	45.60 to 46.10
Basic, Valley	43.00 to 43.50
Malleable, Chicago	43.50
Malleable, Buffalo	46.25

Coke

Connellsville foundry coke	12.00
Wise county foundry coke	12.00 to 12.50

Scrap

Heavy melting steel, Valley	$25.25 to 25.50
Heavy melting steel, Pittsburgh	25.00 to 26.00
Heavy melting steel, Chicago	23.50 to 24.00
Stove plate, Chicago	33.00 to 33.50
No. 1 cast, Chicago	42.50 to 43.00
No. 1 cast, Philadelphia	38.00 to 40.00
No. 1 cast, Birmingham	30.00 to 31.00
Car wheels, iron, Pittsburgh	39.00 to 40.00
Car wheels, iron, Chicago	38.50 to 39.00
Railroad malleable, Chicago	30.00 to 30 50
Agricultural malleable, Chicago	30.00 to 30.50

Mid-west Is Cut Off

All the great industrial section bounded by Pittsburgh, Cincinnati, St. Louis, Chicago, Detroit, and Buffalo is confronted by the danger of complete stagnation. The shortage of all raw materials is prevalent, but the greatest difficulty is experienced in maintaining sufficient coke. The Pennsylvania and the Baltimore & Ohio railroads are moving solid trainloads of coke out of the Connellsville region, and in cases where these full trains can be moved through to destination without intermediate switching, ample supplies may be had. A number of the larger interests in the vicinity of Pittsburgh have been obliged to curtail production and a few have closed. An instance of the uncertainty prevailing is found in Cleveland, where several large jobbing foundries have closed down for a day or two at a time, resumed operations when needed materials were received and then been obliged to cut down to 50 or 60 per cent of normal activity to conserve supplies. Iron scarcity is being felt more severely through Indiana and Illinois, while in St. Louis supplies of iron which have been enroute from Birmingham for weeks have not been received. The scarcity of iron which can be delivered from Chicago is shown by a recent sale of some 500 tons of malleable by an Ohio furnace company to a Wisconsin melter at $46.50 furnace or about $50 delivered. Chicago and northern Indiana furnaces are piling iron. The effects of the strike seem to be almost entirely confined to those industrial sections where keen labor competition exists. In the south and southwest freight movements are free, despite the shortage of cars.

Iron Little Affected

Production of pig iron was but little affected during April according to statistics gathered by *The Iron Trade Review*. Although the railway strike produced a sudden cessation at the start, resumption gradually was noted during the last week of the month. About 40 blast furnaces were forced out of blast and a great number reduced operations, but the April output showed a decrease of only 623,454 tons as compared with March. The April total was 2,752,314, of which 757,227 tons was merchant iron. The merchant iron loss was 105,940 tons, or 9.38 per cent figured on the daily average. The percentage loss shown in the total iron production was 15.8 per cent. It is probable with the continued obstacles encountered early in May, that the present month will show a greater loss in pig iron production. It is stated that southern iron producers have sold practically all their spot iron for the first half of the year and probably half of their average third-quarter output. Southern foundries are flooded with orders, and in some cases are turning away business. The eastern cast-iron pipe shops have been hampered and in some cases have resorted to 4-day operation, although in the past week relief has been obtained. Pipe demand is strengthening in all sections. However, the southern pipe shops are working to capacity. Some inquiry is reported from Cuban interests for sugar mill machinery castings. Southern foundries are taking some of this work. Automobile requirements still are heavy and largely unsatisfied, due to transportation difficulties. Railroads still are inactive in seeking new equipment, but a fair volume of repair business is being placed. Brass and aluminum foundries report a continued strong demand. Prices of nonferrous metals, based on New York quotations, follow: Copper, 18.50c; lead, 8.62½c to 8.75c; tin, 57.00c to 57.50c; antimony, 9.87½c; aluminum, No. 12 alloy, producers' price, 31.50c and open market, 31.00c. Zinc is quoted at 18.37½c to 18.50c, St. Louis.

Comings and Goings of Foundrymen

FREDERICK G. COTTRELL has been nominated by President Wilson to succeed Dr. Van H. Manning as director of the bureau of mines. Dr. Cottrell was born in Oakland, Calif., Jan. 10, 1877. He was graduated from the University of California in 1896 and taught chemistry in the Oakland high school until 1900, when he went abroad and studied at the University of Berlin and the University of Leipzig, receiving degrees from the latter institution. Returning to this country, he was assistant professor in physical chemistry at his own university until 1911. During this time he evolved the Cottrell process of electrical precipitation of fumes and fine particles suspended in the gases of smelter, blast furnace and cement works. In 1911, when Dr. J. A. Holmes, the first director of the bureau of mines was appointed to study the question of smoke damage from smelters, Dr. Cottrell was appointed chief physical chemist of the bureau. In 1914 he became chief chemist, in 1916 chief metallurgist and in 1919, assistant director. Dr. Van H. Manning, who has tendered his resignation as director, effective June 1, is leaving the government service to become director of research with the recently organized American Petroleum institute. Dr. Manning has been in active service with the department of the interior for the past 34 years.

G. Johnson, who formerly was with the Wellman-Seaver-Morgan Co., Akron, O., has been made foundry superintendent for the Minerva Engine Co., Cleveland.

George N. Jeppson, secretary and works manager of the Norton Co., Worcester, Mass., will sail for Europe May 15, combining business with pleasure.

George A. Laub, formerly with the American Car & Foundry Co., has become superintendent of the plant of the Sligo Iron & Steel Co., Connellsville, Pa.

P. A. Gaynor, formerly manager of service and sales for the Bryan Pattern & Machine Co., Bryan, O., has assumed similar duties with the Non-Ferro Foundry & Pattern Co., 1361 West Bancroft street, Toledo, O.

Fred T. Moran, Detroit stove manufacturer, has been elected a director of the Charcoal Iron Co. of America, succeeding George J. Webster, of Marquette, Mich., retired. Other directors were re-elected.

Frank E. Lampson, who for many years has been in charge of the shipping and receiving departments of the Sessions Foundry Co., Bristol, Conn., has been made an assistant to President William E. Sessions.

Bushnell Bigelow, formerly eastern manager of sales for the New Jersey Zinc Co., New York, has been appointed assistant general sales manager of that company. Walter I. Hess succeeds Mr. Bigelow as manager of eastern sales.

R. W. Gallager, assistant general manager of the East Ohio Gas Co., Cleveland, will resign June 1 to become acting president of the Motor Castings Co., Canton, O. The Canton plant manufactures motors for trucks and tractors.

Charles H. Noble, president of the Vi Brass & Aluminum Co., Massillon, O., died recently at the age of 60 years. Mr. Noble who was a resident of Lima, O., was engaged in the work of establishing the Massillon foundry at the time of his death.

K. M. Glass and J. A. Arthur recently have incorporated the Glass-Arthur Iron & Brass Foundry and have started operations in Gastonia, N. C. Mr. Glass formerly was connected with Bartlett & Haywood, Baltimore, while Mr. Arthur until recently was foreman of the Moffet Machine Co., Charlotte, N. C.

Boetius H. Sullivan was elected chairman of the board of directors at a recent meeting of the Independent Pneumatic Co., Chicago. The other officers chosen were John D. Hurley, president; Ralph S. Cooper, first vice president; Fletcher W. Buchanan, secretary, and Edward G. Gustafson, treasurer.

A. Leon Scott has been made sales manager for the Arcade Malleable Iron Co., Worcester, Mass. Until recently Mr. Scott was sales agent of the Naugatuck works of the Eastern Malleable Iron Co. and during his affiliation with that organization he received a varied and world-wide experience in marketing castings.

A. M. Fulton, for the past 13 years with the Fort Pitt Malleable Iron Co., Pittsburgh, resigned on May 1. Mr. Fulton served the company in various capacities and for the last three years has been general superintendent. He has always taken a general interest in foundry association affairs and now is president of the Pittsburgh Foundrymen's association.

A. B. Van Eschen, formerly works manager, Michigan Steel Casting Co., Detroit, has formed a syndicate which has purchased the Monroe Steel Casting Co., Monroe, Mich. The plant is equipped with a one and a half-ton Booth-Hall and a one-ton Snyder electric furnace. The new interests will thoroughly modernize the property, installing the necessary equipment to put it on a high production basis. C. F. Clark, formerly treasurer of the Steel Products Co., Detroit and Cleveland, has been elected president.

E. B. Horne recently resigned his position as manager of the forge and foundry divisions of the Packard Motor Car Co., Detroit. Mr. Horne had been with the Packard company for the past 12 years. He intends to devote his attention to personal interests, particularly the Rochester Foundry & Machine Co., Rochester, Mich., of which he is president. This company now is engaged in the production of iron, brass and aluminum castings and patterns. The addition of a malleable department is contemplated.

Harry Carson has resigned his connection with Rogers, Brown & Co., to organize Carson & Co., with headquarters in the Pennsylvania building, Philadelphia. Carson & Co. will conduct a general brokerage business, handling foundry and steel mill supplies, including pig iron, coke and ferroalloys. Mr. Carson's connection with the Rogers, Brown interests dates back 20 years, first at Buffalo with the Rogers, Brown & Co., and the Rogers-Brown Iron Co., and later at the Philadelphia office of Rogers, Brown & Co.

New York Foundrymen Discuss Costs

In preparation for a joint meeting on May 12 of the Newark Foundrymen's association, in conjunction with the Gray Iron club, New York, the former association sent out a blueprint with the request that all of the members quote their best price per pound, at the foundry. At the meeting the quotations were opened as at a public letting and the various bidders were asked to justify their quotations explaining how they are made up.

The Newark Foundrymen's asso-

ciation now is quoting from its members' information with respect to their yearly consumption of pig iron, the districts from which the pig iron is obtained, present freight rates, and present means of unloading and receiving the pig iron. This information is desired so that the proposed increase of freight rates to Newark can be taken up with the newly-formed traffic section of the board of trade of Newark.

Bill Comments on Blast Furnace Coolers

(*Concluded from page 415*)

verted into steam. It also is a matter of common knowledge that steam occupies an immense space compared to the volume of water from which it was derived. You probably have found out those things for yourself tonight so I will not dwell any longer on that point.

"When the mold was ready for the iron, a length of hose was connected to a tap on the city water supply and the other end was slipped over the end of one of the protruding pipes in the mold. Another short piece of hose was attached to the second pipe, the free end of the hose being led into the water barrel to receive the overflow. The ladle of iron was swung around on the crane and most of the men in the shop crowded uo to watch the performance. When the mold was about one-quarter full the steam pressure jerked the hose loose from the water tap and you can imagine what happened after that. The two pieces of hose jumped and flew around as if they were alive, squirting steam and boiling water at every jump. The shop was low and dark and full of steam and the garg just trusted to instinct and broke away in all directions. A few managed to reach the door; some jumped out through the windows; others landed in the core oven; one innocent young man who had left the farm and came to the town to make his fortune got such a fright that he never came back even for his back time. After the excitement died down, I found myself in the bottom of the coal box behind the stove with a big hairy molder on top of me.

"The next day the old man threw the hose out the window. We made another mold, gated it tangentially near the bottom, poured the metal a little on the dull side and there was no more excitement about it than there would be about pouring a button for the back door. We made several after that, but never tried to water cool any of them with a piece of hose loosely connected to the water tap.

"As I said before, the idea is all right. I saw it adopted many years afterward in casting steel rams for open-hearth charging machines. Considerable trouble had been experienced in cleaning the cores out of these castings so it was decided to use an extra heavy 4-inch steel tube for a core. The tube was made long enough to extend through both ends of the flask; it was threaded at both ends and suitable connections for 1-inch pipes attached. The water was turned on about a minute before commencing to pour the steel and left running until the casting was set. When cleaning the casting the tube was cut off flush at both ends leaving a perfect hole which required no cleaning."

"All right," I said, "let's forget that work stuff for a while. If you wait a few minutes until I wash my face and hands. I'll try to borrow 15 cents and shoot you a game of pool."

"Forget it," said he, "I've got a quarter, come on." It was not until he had trimmed me four times in succession that I got the full import of the words "come on."

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The F. & H. Foundry Co., Newark, N. J., is having plans drawn for the erection of a plant.

The Mt. Carmel Brass Co., Hamden, Conn., plans the erection of a plant addition.

The core room and foundry of the Vulcan Plow Co., Evansville, Ind., recently was damaged by fire.

Erection of a foundry, 60 x 100 feet, is planned by the Walker Machine & Foundry Co., Roanoke, Va.

The plant of the Mahanoy City Foundry & Machine Co., Mahanoy, Pa., recently was damaged by fire.

Balke & Co., iron founders, Louisville, Ky., have increased their capital from $25,000 to $50,000.

The Ashland Foundry & Machine Shops, Ashland, Ky., recently were damaged by fire.

The Bay View Foundry Co., Sandusky, O., has increased its capital from $200,000 to $300,000.

The plant of the Schultheiss Mfg. Co., Los Angeles, has been acquired by the Hercules Foundry Co.

The foundry of the Gross Mfg. Co., Hazelton, Pa., recently was damaged by fire.

Extensions to its plant are being planned by the C. E. Davis Foundry Co., Rutland, Vt.

The Elliot Foundry Co., 129 North Clark street, Chicago, contemplates the erection of a foundry.

The Harrison Safety Boiler Works, Norristown, Pa., contemplates the erection of an addition to its foundry, 25 x 48 feet.

A foundry, 16 x 200 feet, is planned by the American Radiator Co., 1807 Elmwood avenue, Buffalo.

The Eastern Malleable Iron Co., 719 South avenue, Bridgeport, Conn., has plans for the erection of a foundry, 68 x 179 feet.

The Akron Brass Mfg. Co., Wooster, O., plans the erection of a shop building, one story, 40 x 185 feet.

The Hudson Brass Works, 16 Nassau street, Brooklyn, N. Y., has awarded a contract for the erection of a plant, 100 x 300 feet.

The capital stock of the Terre Haute Malleable & Mfg. Co., Terre Haute, Ind., has been increased from $100,000 to $1,000,000.

The Chicago Faucet Co., 2716 Crawford avenue, Chicago, has let a contract for the erection of an addition to its foundry, 54 x 100 feet.

The Oregon Foundry Co., Portland, Oreg., recently was incorporated with a capital of $15,000, by H. E. Harris, Milton B. Henderson and others.

Plans have been prepared for the erection of a 2-story addition to the plant of the Stroh Castings Co., Detroit.

The capital stock of the Maumee Pattern Co., Toledo, O., recently was increased from $10,000 to $100,000.

John N. Miller, 145 Gertrude court, Pasadena, Cal., and others, have organized the Pasadena Foundry Co.

Plans have been prepared for the erection of an addition to the plant of the Standard Brass Casting Co., Oakland, Cal.

Plans are being prepared for the erection of a foundy, 70 x 180 feet, by the Union Railroad Equipment Co., 332 South Michigan avenue, Chicago.

Plans are being prepared for the erection of a building, 25 x 30 feet, for the Keeley Stove Co., Columbia, Pa.

The Beaver Valley Alloy Foundry Co., Rochester, Pa., has been incorporated with a capital of $30,000, by Charles E. Coleman and others.

Erection of an addition to its plant, one story, 30 x 75 feet, is contemplated by the Henry Peppert Pattern & Mfg. Co., 505 Cedar street, Milwaukee.

The capital stock of the Pitz & Weber Iron Foundry, New York, has been increased from $150,000 to $250,000.

The capital stock of the Liberty Foundry Co., Detroit, recently was increased from $25,000 to $100,000.

The chamber of commerce of Richmond, Mich., has arranged for the establishment of a foundry, on a 10-acre site, which will employ about 200 men.

The Monarch Brass Works, Louisville, Ky., has been incorporated with a capital of $20,000, by Charles F. Grainger and others.

The Bay City Foundry & Machine Co., Bay City, Mich., whose foundry recently was damaged by fire, plans to rebuild immediately.

Capitalized at $50,000, the Barberton Foundry Co., Akron, O., has been incorporated by J. A. Lanigan, A. F. O'Neil and others.

The Independent Foundry & Machine Co., Punxsutawney, Pa., recently was incorporated with a capi-

tal of $25,000, by G. Frank Porter and others.

The Lukenheimer Co., Carthage, O., has plans for the erection of an addition to its foundry, 230 x 301 feet.

The A. J. Detlaff Co., 121 Lafayette avenue, Detroit, plans the erection of an addition to its foundry, 51 x 87 feet.

A foundry and machine shop is being planned for the Richmond Foundry & Machine Co., Richmond, Mich.

Erection of an addition to its core room, two stories, 72 x 100 feet, is being planned by the Odin Stove Mfg. Co., Erie, Pa.

The Loomis Selaff Co., 6616 Morgan avenue, Cleveland, has plans for the erection of a foundry, 60 x 120 feet.

The McFarland Foundry & Machine Co., Trenton, N. J., plans the erection of a foundry building, 50 x 120 feet.

The Buckeye Steel Castings Co., Columbus, O., recently increased its capital from $2,500,000 to $4,500,000.

Erection of an addition to its foundry is being planned by the Pratt Chuck Co., 43 Cedar street, Oneida, N. Y.

The Mark Mfg Co., Houston, Tex., contemplates the erection of an addition to its plant, which will include a foundry.

Capitalized at $60,000, the Ornamental Foundry Co., Anniston, Ala., recently was incorporated by C. A. Hamilton and others.

The Wood-Embly Brass Co., Rouzerville, Pa., plans to rebuild its plant which recently was damaged by fire.

The J. W. Richardson Foundry & Metals Corp., Brooklyn, N. Y., recently increased its capital from $15,000 to $30,000.

The Sterling Die Casting Co., Brooklyn, N. Y., recently increased its capital from $120,000 to $180,000.

B. F. Avery & Sons, Inc., Louisville, Ky., recently increased its capital to finance the erection of an addition to its plant.

The Kentucky Wagon Mfg. Co., Louisville, Ky., has purchased eight acres on which it plans to build additional foundry and machine shops.

The Hampden Brass Co., Springfield, Mass., has let a contract for the erection of an addition to its foundry, 82 x 50 feet.

Capitalized at $50,000, the Hatboro Foundry Co., Hatboro, Pa., recently was incorporated by William W. Wilgus, Albert E. Koch, Kenkintown, Pa., and Melvin W. Stryker.

The J. F. Tice Co., Lagrange, Ga., which was recently incorporated with a capital of $25,000, will engage in the manufacture of castings J. F. Tice is president of the company.

Plans are being prepared for the erection of an addition to the plant of the Anderson Foundry & Machine Works, Anderson, Ind. The building will be 130 x 220 feet.

Cohen-Radow, iron foundry, Brooklyn, N. Y., recently was incorporated with a capital of $10,000, by S. and I. Cohen, and B. Radow, 1150 President street.

Work has been started by the Galt Brass Co., Galt, Ont., on the erection of two plant additions. The foundry will be 60 x 140 feet and the other structure 40 x 50 feet.

Capitalized at $400,000, the Ontario Foundry Co., Ltd., Toronto, Ont., recently was incorporated by Peter Kirkegaard, Wilfred W. Parry, Horace B. Proudlove and others.

The Western Reserve Foundry Co., Cleveland, recently was incorporated with a capital of $50,000, by A. F. Gaughan, R. E. Collins, Williamson building, and others.

The Des Moines Foundry & Machine Co., Des Moines, Iowa, plans the erection of a foundry and machine shop. C. N. Schmitt, 314 Flynn building, is manager of the company.

The Detroit Ring Casting Co., Detroit, recently was incorporated with a capital of $125,000, by John Magee and others, to engage in a general foundry business.

The Wabash Valley Mfg. Co., Perryville, Ind., recently was incorporated with a capital of $5000 to conduct a general foundry business, by Charles H. Cochran, Emil R. Johns and Paul J. Hawkins.

The Illinois Malleable Iron Co., Chicago, has a permit to erect a plant building.

A site has been purchased by the Bernert Mfg. Co., 489 Twelfth street, Milwaukee, on which it plans the erection of a plant, 120 x 260 feet, which will include a foundry and machine shop.

Capitalized at $75,000, the Aetna Brass Mfg. Co. recently was incorporated by E. H. Krueger, Illuminating building, Cleveland, E. R. Carbaugh, C. G. Townes, H. Comstock and others.

Architect Z. E. Smith, 305 East Fifty-fifth street, Chicago, is preparing plans for the erection of a foundry and machine shop, 50 x 100 feet, for the Duroal Ingraham Steel Co.

The Seville Foundry & Machine Co., Seville, O., recently was incorporated with a capital of $60,000, by J. R. Minton, H. J. Freeman, C. V. Matteson, N. L. Williamson, J. C. Murray, O. Smith and F. C. Bauer.

The Loeffler Machine Co., Sheboygan, Wis., capitalized at $100,000, has been chartered to take over the business of William Loeffler Machine Co., and will erect a gray iron foundry, 80 x 132 feet, and a machine shop addition, 40 x 100 feet.

The West Bridgewater Foundry, West Bridgewater, Mass., recently was incorporated with a capital of $10,000, by Cecil E. Whitney, Newton, Mass., Abram Berkowitz, Boston, and John F. Rollins, Cambridge, Mass.

The Blackhawk Foundry & Machine Co., Davenport, Iowa, recently was incorporated with a capital of $80,000, to conduct a general foundry and machine shop, by Walter K. Voss, Howard W. Power, Henry W. Huber and Harry F. R. Voss.

The Gunning Iron & Brass Foundry, Inc., New Bedford, Mass., recently was incorporated to operate a foundry and machine shop, with a capital of $50,000, by Andrew Gunning, John B. Lowney, H. L. Potter, George R. Dahn and others.

To care for the expansion in its business and to operate an additional foundry at Toledo, O., the Detroit Stoker Co., Detroit, recently increased its capital to $200,000. For the present equipment requirements have been taken care of.

Capitalized at $200,000, the Elizabeth Foundry Co., Newark, N. J., recently was incorporated by George W. Porter, Gustave Hausmann and Alfred W. Cooper.

Extensions are being made to its steel foundry by the National Brake & Electric Co., Milwaukee, for increasing its molding floor space. It also is adding another 15 to 20-ton tilting open-hearth furnace to its equipment.

Improvements made possible by an increase in capital stock will practically double the capacity of the Marysville, O., plant of the Regent Brass Foundry Co., 826 Lakeside avenue, Cleveland. Sidney L. Fisher is vice president of the company.

Instead of erecting a new plant, consisting of foundry and machine shops, the Milwaukee Ice Machine Co., 1001 Cold Spring avenue, Milwaukee, has purchased the plant of the Steam Appliance Co., West Allis, Wis., and has abandoned its original construction plans.

The American Furnace & Foundry Co., Milan, Mich., recently was organized with a capital of $100,000, to manufacture furnaces. The company will erect a plant, 80 x 250 feet, the contract for which has been let. Officials are: President, E. L. Watson; vice president, E. D. Minzey; general manager, F. E. Fulkerson, and secretary and treasurer, F. E. Ross. It is expected the company's plant will be ready for operation about Aug. 1

Molding machines, screw machines, milling machines, air compressors, etc., are needed by the Regle Brass Co., Greenville, Mich., which recently completed the erection of a plant, 60 x 200 feet. The plant is equipped with 10 brass furnaces, nickel plating, polishing, machine and tool rooms. For the present the company's efforts will be confined to the manufacture of plumbers' brass. The company, which is capitalized at $100,000, expects to be in a position to start marketing its products by July 1.

New Trade Publications

HOISTS.—Electric hoists, chain blocks, cranes and trolleys are described and illustrated in a small booklet recently published by the Franklin Moore Co., Winsted, Conn. Specifications are given.

INDUSTRIAL TRUCKS.—An illustrated folder has been prepared by the Clark Tructractor Co., Chicago, showing industrial trucks which it manufactures, at work, and the various types which are adapted to different work.

FLEXIBLE ARM. The Breeze Mfg. Co., Newark, N. J., has issued a folder in which a flexible metal arm for electric light fixtures is described and illustrated. This arm according to the folder, directs the light 100 per cent to the spot where it is required. Construction details and other data are given.

FLEXIBLE TUBING.—The Breeze Mfg. Co., Newark, N. J., has prepared a 36-page booklet in which flexible metal hose, tubing and accessories are described and illustrated. General data are given concerning the various uses of this material, and the technical information should be of value to engineers.

ELECTRIC HOISTS.—A booklet has been published by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., in which electric hoists are described and illustrated. The illustrations show the various work to which these hoists can be put, and installations ranging from the transportation of soup to the assembling of motor cars are shown.

HAMMERS.—The David Maydole Hammer Co., Norwich, N. Y., has published two booklets in which hammers which it manufactures are described and illustrated. One booklet is a pocket catalog, and besides containing information concerning the hammers, contains a story of the life of David Maydole, a number of interesting tables, and general information useful to mechanics, etc. The second booklet contains detailed information and specifications of the hammers.

FRICTION CLUTCHES.—A booklet has been published by the Carlyle Johnson Machine Co., Manchester, Conn., in which the achievements of friction clutches in the field of machine designing are outlined. Applications of friction clutches to the various machine tools are illustrated and described in detail, showing the flexibility of design. Other details of interest are given.

METALLIC TUBING.—The Pennsylvania Flexible Metallic Tubing Co., Philadelphia, has published a booklet in which flexible metal hose is described and illustrated. This tubing consists of a continuous bronze or steel tape, rolled in a spiral, so that the edges interlock, forming a 4-wall construction. As the tape is rolled a groove is formed, which contains an asbestos packing to protect the tubing from wear. Other details are given, as well as the various purposes for which this tubing is adapted.

SOLDERING IRONS.—Electric soldering irons are described in a 4-page leaflet recently published by the Cutler-Hammer Mfg. Co., Milwaukee. In addition to the irons, associated equipment, including automatic racks, soldering fixtures and current regulators for current control are described in the leaflet. Mention is made of the sealed core of the soldering iron, which according to the leaflet, is impervious to heated acid, solder or moisture. A renewable copper tip screws over the heater core, where the heat is concentrated. The leaflet besides giving details as to the equipment, lists five different sizes of irons, enumerating the kind of work to which each size is adapted.

THE FOUNDRY

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Old Firm Erects Modern Foundry

Built to Cope with the Company's Expanding Punch and Shear Business, This Plant Now Handles Overflow Machine Tool Casting Business of the Vicinity

UNPRECEDENTED demand for plates and structural steel shapes during the past few years, while primarily affecting the mills also has been reflected in the machine tool industry, especially among plants making those tools employed in the yards and shops where this material is fabricated. Punches, shears, single and multiple drills, bending and straightening rolls, presses, hot and cold saws, bulldozers and other forms of mechanical equipment while made in ever increasing quantities, have not been supplied to meet the requirements in this particular field. Many orders for these tools emanated from new concerns, but the majority were, and are, from firms expanding plants to handle a larger volume of business. Methods change with the times in steel fabricating, as in every other line of endeavor, and tools and equipment which were considered the last word in efficiency a few years ago, now, in a great many cases are considered fit only for the scrap pile and entered as such on the yearly inventory. A machine capable of punching or drilling one hole at a time was fast enough in the days when a pair of skillful two-handed riveters required 10 hours in which to drive 120 cone-head rivets in the lapped joint of a boiler sheet, but it had no place in a yard where each riveting gang accounted for at least 2000 holes a day as they did in the sides of vessels ordered by the Emergency Fleet corporation.

Rolling stock on the railroads has been growing steadily in size and quantity in recent years and machinery manufacturers have done their best to keep pace with the increased demand for larger and more efficient types of machine tools particularly adapted to that class of work. The same is true in the automobile industry, in building bridges and steel frame buildings and other forms or expressions of

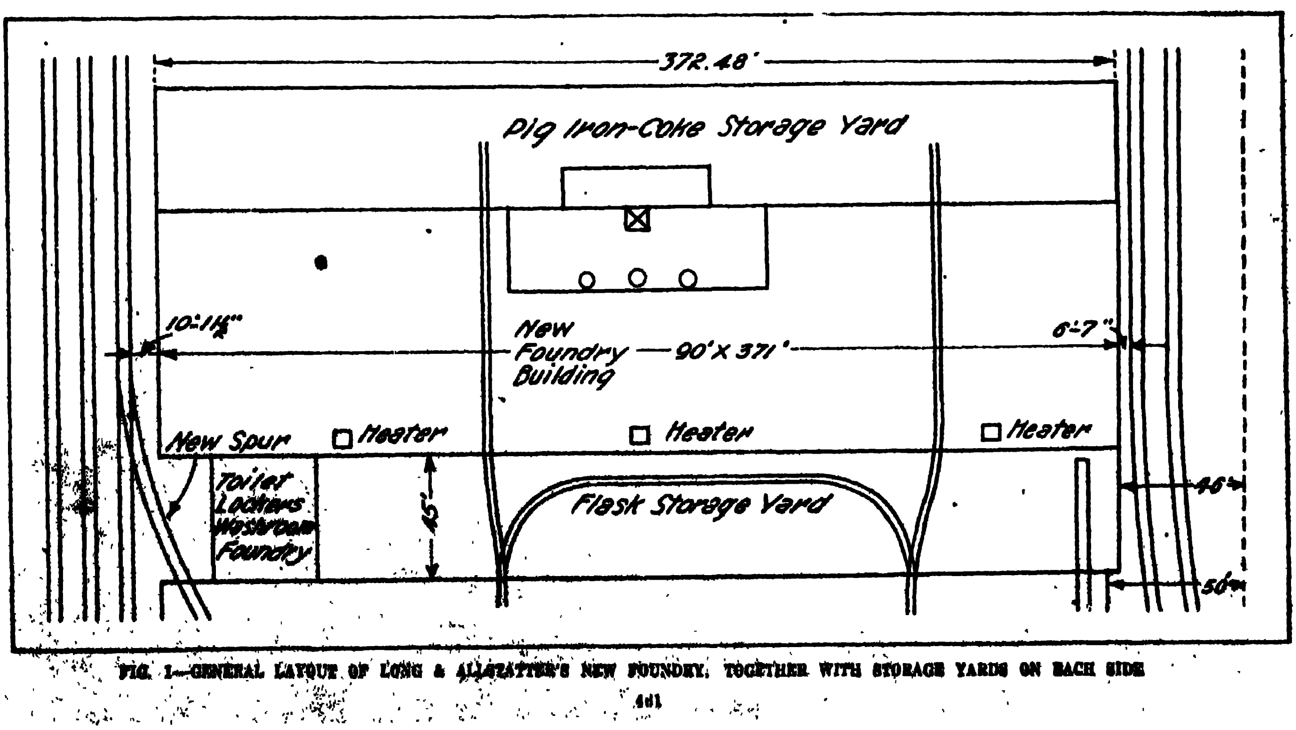


FIG. 1—GENERAL LAYOUT OF LONG & ALLSTATTER'S NEW FOUNDRY, TOGETHER WITH STORAGE YARDS ON EACH SIDE

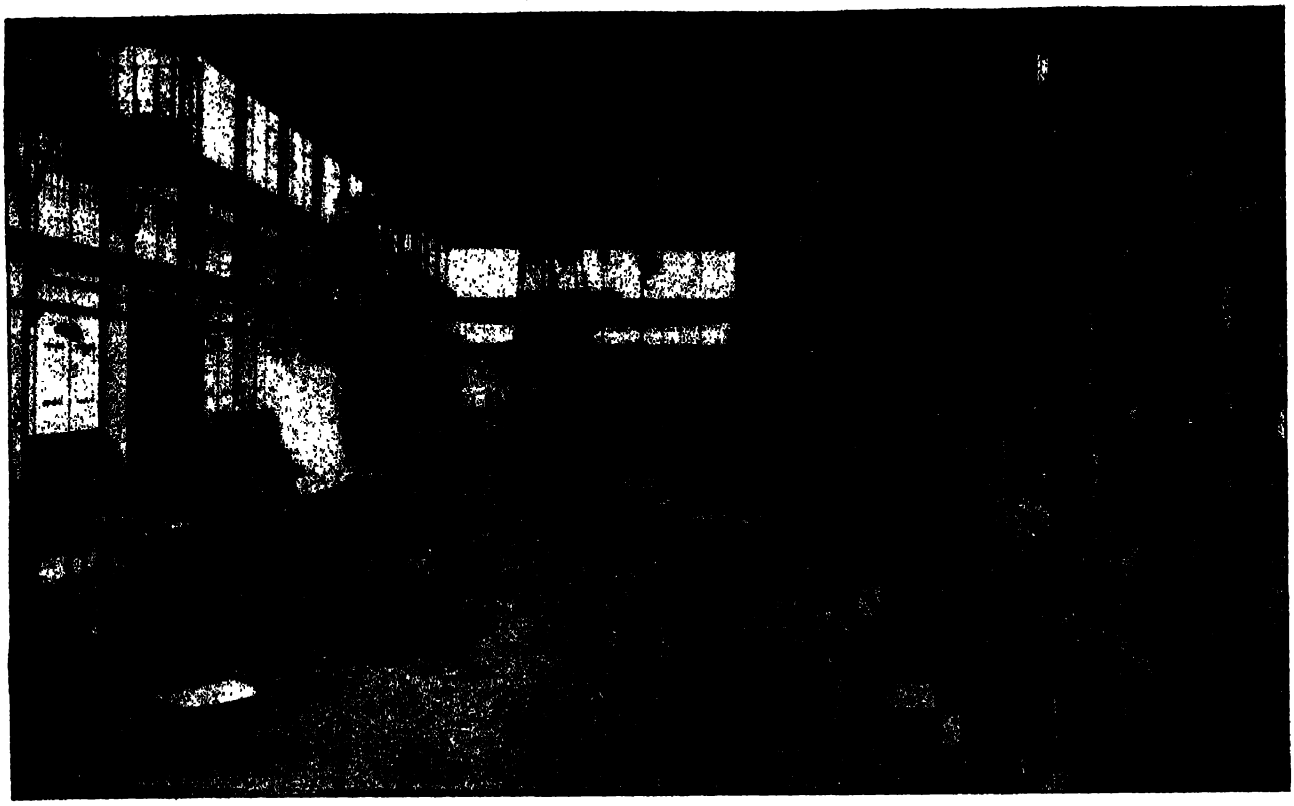


FIG. 2 -GENERAL VIEW OF THE INTERIOR LOOKING WEST—NOTE THE CRANE ON THE LOWER TRACK, THE CLAM SHELL BUCKET AND THE HEATERS

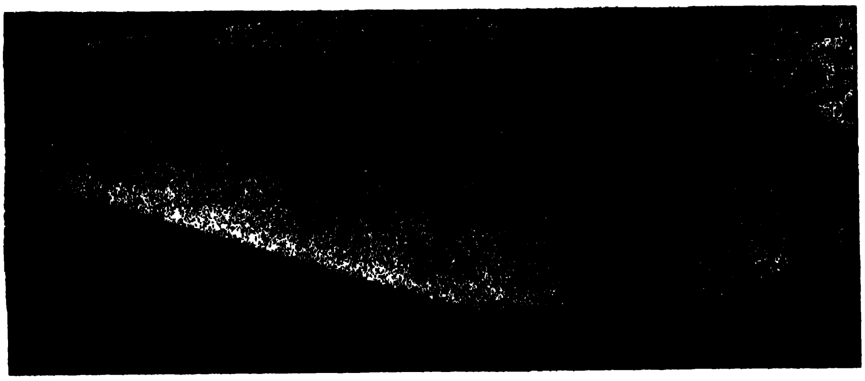


FIG. 3—CASTING FOR OPEN SIDE PLANER BED—IT IS CAST IN THE POSITION SHOWN—CORES TO FORM THE POCKETS FORM AN INTEGRAL PART OF THE COVER CORES

industrial activity based on fabricated metal parts.

Prominent among the firms engaged in this line is the Long & Alstatter Co., Hamilton, O., which recently has completed and placed in operation a strictly modern foundry for the production of a wide and varied line of punches, shears and other machinery employed in fabricating plates and shapes. The plan, Fig. 1, indicates that the shops of this company are situated between the Baltimore and Ohio railroad on one side and the Pennsylvania railroad on the other and that

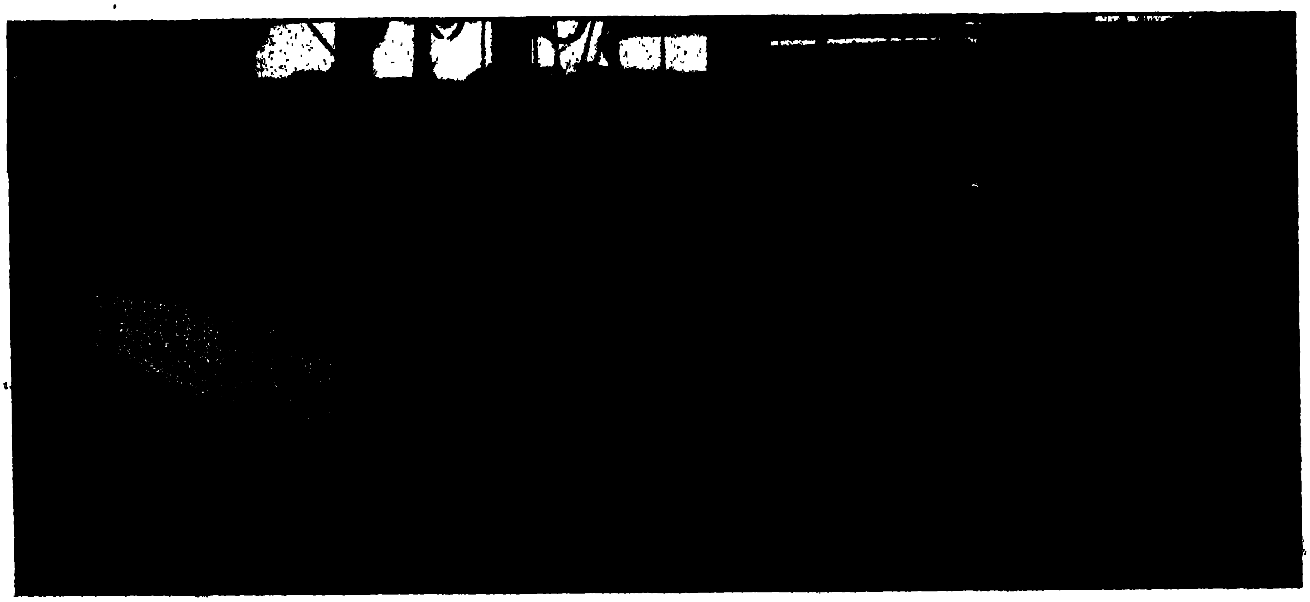


FIG. 4—SAME CASTING SHOWN IN FIG. 3 JUST AFTER COMING OUT OF THE SAND—THE COVER CORES TAKE THE PLACE OF A COPE

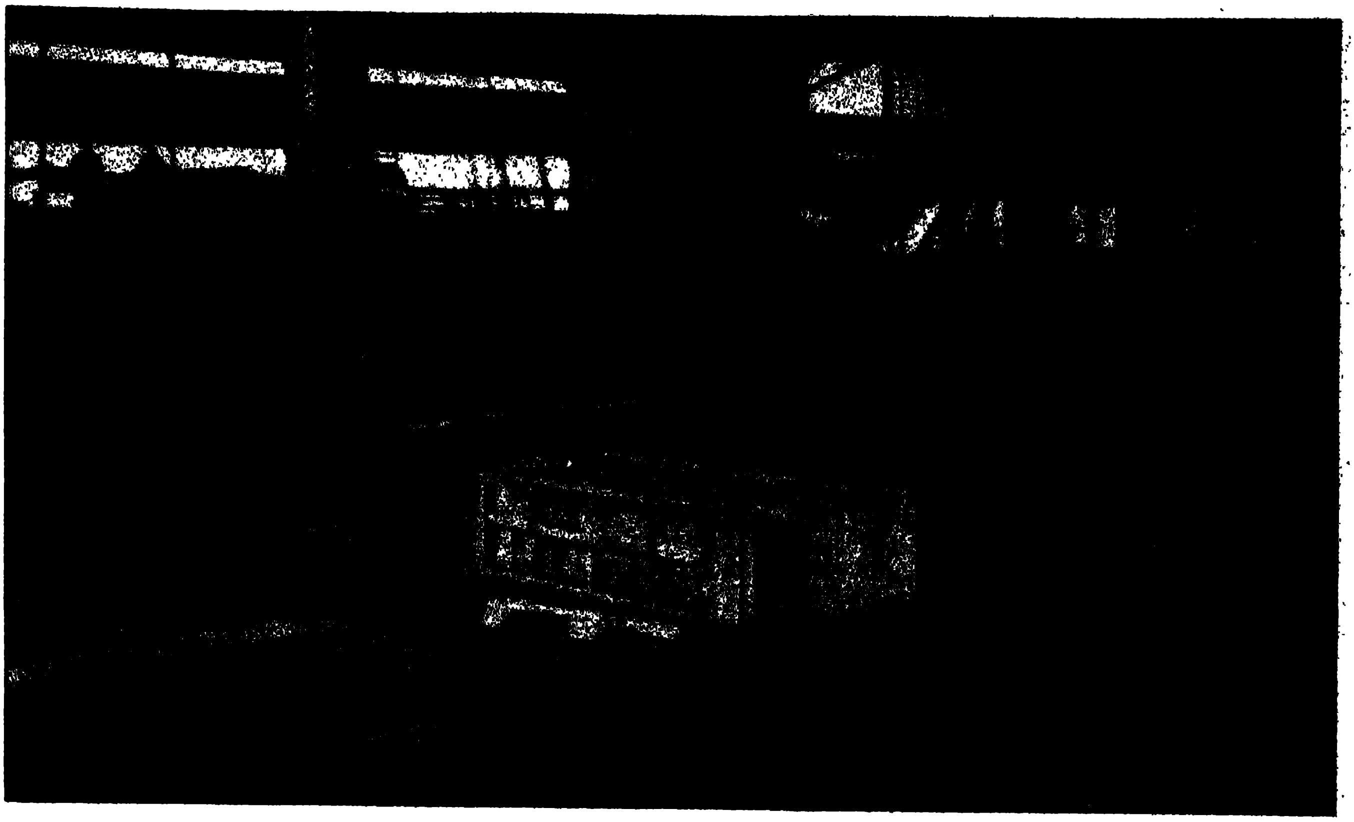


FIG. 5—CORE OVENS AND CARS, ALSO COREBOX FOR PLANER BED—THE LARGE PLATES COVERING THE CAR BODIES ARE PLANED PERFECTLY TRUE AND MANY CORES CAN BE MADE WITH SIMPLE FRAMES

they occupy a whole city block approximately 400 feet square. A spur from each of these railroad lines enters the plant from each side affording excellent shipping facilities for the finished product as well as convenience in receiving supplies and raw materials.

The brick foundry building which served the company for many years has been torn down and the new machine shop is taking its place. A modern, up-to-date, foundry of greatly increased capacity has been

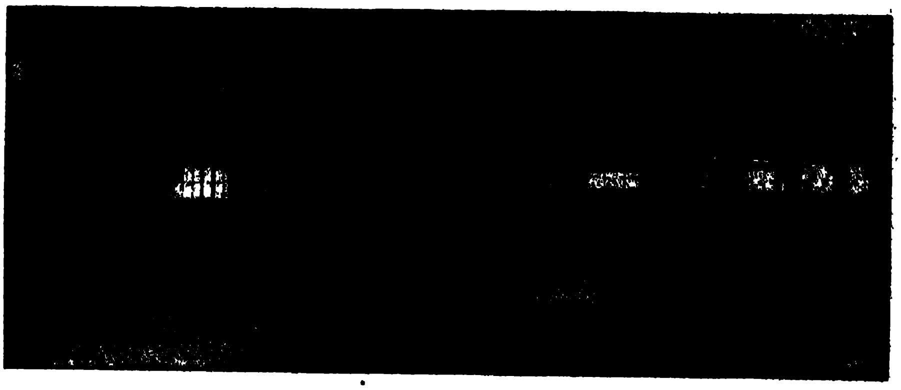


FIG. 6—THE FRONT OF THE CUPOLAS, MEZZANINE FLOOR AND CHARGING PLATFORM

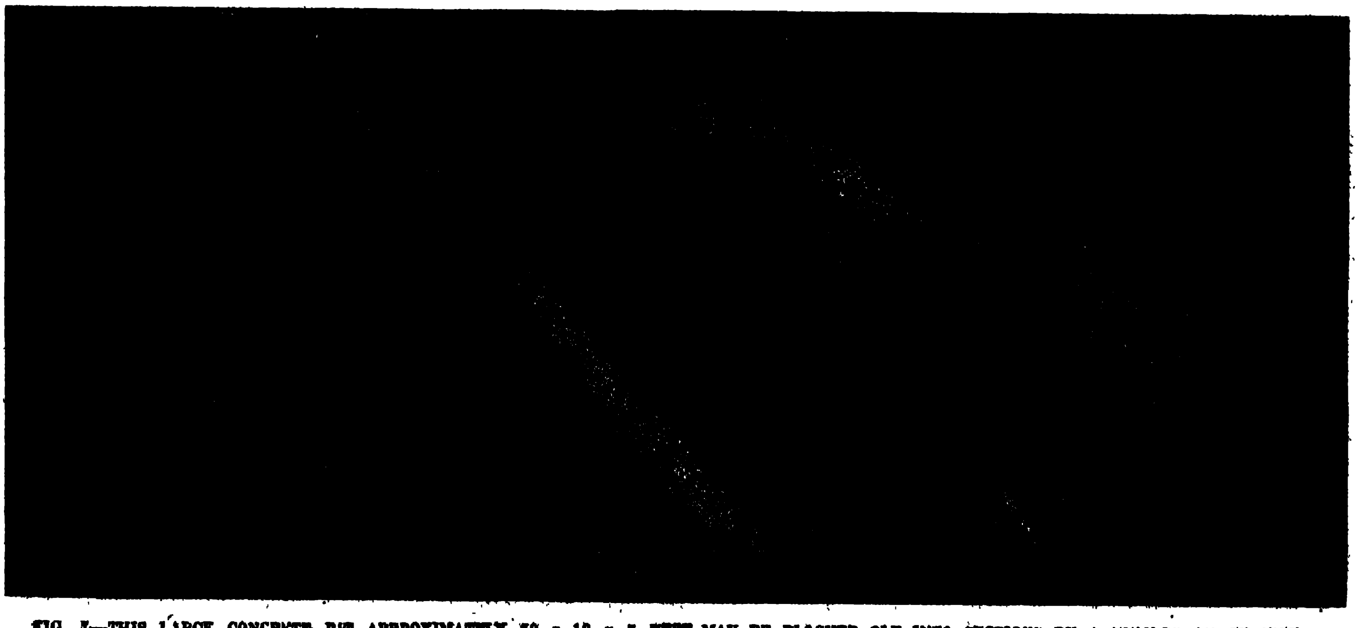


FIG. 7—THIS LARGE CONCRETE PIT APPROXIMATELY 50 x 18 x 5 FEET MAY BE BLOCKED OFF INTO SECTIONS BY A NUMBER OF CHANNELS

erected on the north end of the company's property. It is separate from the new machine shop by the foundry flask yard 45 feet in width and from the street line on the north by the pig iron, scrap and coke storage yard 50 x 370 feet. This yard is spanned by a 10-ton traveling crane made by the Northern Engineering Works, Detroit. Pig iron is unloaded and stacked into piles by the aid of a magnet suspended from the crane and the coke is handled by a clam shell bucket. The charging floor of the cupola is provided with an extension which projects into the yard and the crane is employed to lift materials for the charge onto this platform. From this point, they are carried into the charging room and piled in close proximity to the cupola. There are instances where the man who charges the cupola or who has charge of the gang which does the charging, knows his business and of course in cases of that kind, the work will be done properly, but in a great many shops at the present time the men who charge the cupolas, when left to themselves to handle the charge, are likely to produce startling results. Uneven charging will result in uneven melting and uneven melting will be reflected in castings that are scrapped on account of cold shuts, blow holes and shrinkage spots due to oxidized metal.

These and other contingencies are met by having each charge of iron made up on a definite pile and by loading the coke in cans. A certain number of cans are allowed for each charge of iron and the chances of making a mistake are reduced to a minimum. At the present time two cupolas made by the Whiting Foundry Equipment Co., Harvey, Ill., one lined to 45 inches and the other to 54 inches, are used alternately for melting the iron. The heats run from 25 to 30 tons a day. Provision is made in the foundry layout for an additional cupola 90 inches in diameter when the nature and character of the work warrants the installation.

The foundry measures 90 x 370 feet. Steel and concrete were employed in its construction and, as may be noted in the various illustrations, it is particularly well supplied with lighting and ventilating facilities. The main bay is equipped with two 30-ton electric traveling cranes manufactured by the Whiting Foundry Equipment Co., Harvey, Ill., and one 5-ton crane made by the Northern Engineering Works, Detroit, Mich. The light crane travels on a lower track below the others and relieves them of a great deal of light lifting particularly in connection with loading and unloading the core cars. The side bay is divided into three sections occupied respectively by a side floor which is served by a 5-ton Northern crane; the cupola room, which as already stated contains two cupolas and sufficient room for a third; and the core room which also includes the space taken up by the ovens.

A view of the main bay is shown in Fig. 2; from this view it will be seen that most of the work is bedded in the floor. The molds are skin dried either by wood, charcoal, or gas, the molds in the floor being covered with sheets of corrugated iron for that purpose and the copes being set on suitable stands such as those shown in the right foreground in Fig. 2. Many of the copes are made of wood and are provided with trunnions on the sides so that they can be rolled over readily. These flasks are relics of the old shop and according as they wear out, they are not repaired but are scrapped and replaced with iron flasks. At the present price of lumber it is claimed that iron flasks are as cheap as wooden ones, and they certainly give better satisfaction over a longer period. Scarcity of lumber long ago forced European foundrymen to adopt the iron flask permanently even for the smallest sizes and the indications are that the American foundries are heading the same way.

Some of the castings made by this

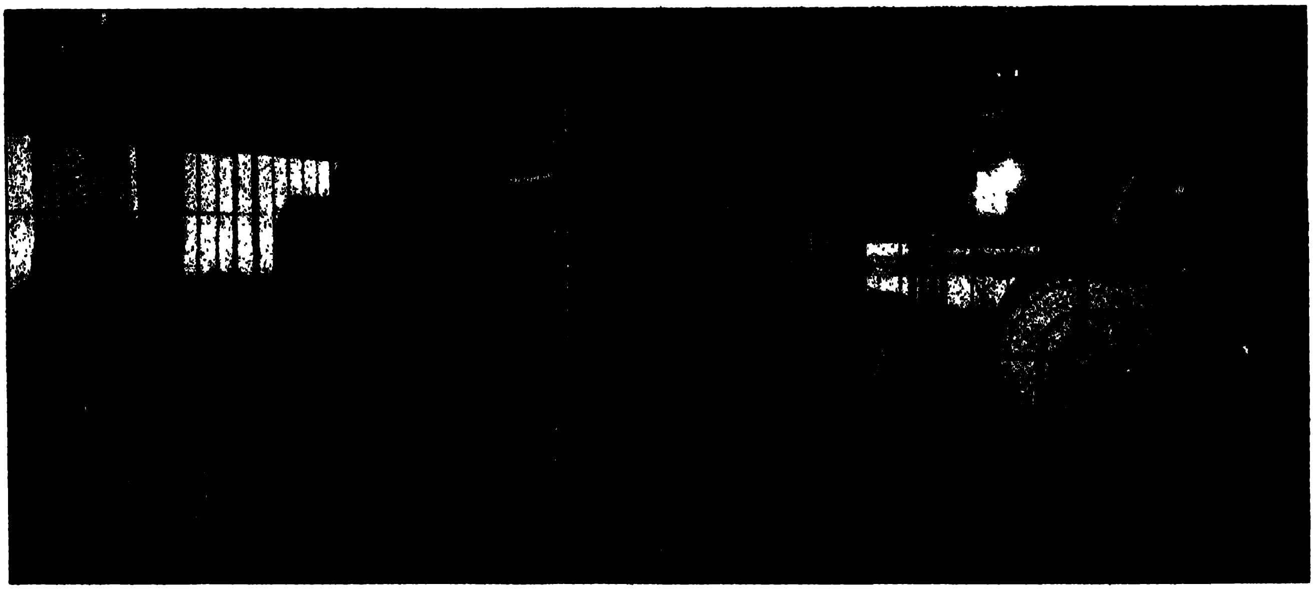


FIG. 8—ELECTRICALLY DRIVEN CENTRIFUGAL COMPRESSOR ON THE LEFT—POSITIVE PRESSURE BLOWER FOR THE 54-INCH CUPOLA ON THE RIGHT—SMALL COMPRESSOR NOT SHOWN

A number of wooden platforms are employed to facilitate making up and handling the charges. They are placed at various points in the yard and the proper amount and quality of iron is placed on each, after which they are picked up by the crane and deposited on the extension platform outside the charging room. The platforms are mounted on two transverse side pieces of plank so that when they are resting on the ground it is possible to run a lift truck under them and convey them to any designated point on the charging floor.

Coke is unloaded from cars by a clam shell bucket and the same bucket is employed to fill the circular cans which are used in making up the charges for the cupolas. It is extremely difficult, as every foundryman knows, to have the coke charged uniformly when it is taken up to the charging platform and dumped there.

company are large and bulky and a casting pit 18 x 50 x 5½ feet has been provided near the center of one side of the main bay to facilitate handling work of this character. The bottom of the pit and the side and end walls are constructed of concrete, the walls coming flush with the foundry floor. A number of I-beams provided with handles and rows of holes at suitable intervals are employed to block off any desired section of the pit when necessary. In this way there always is a definite rigid enclosure around the body of sand composing the bottom or drag part of any mold and there is no danger that the pressure of metal will strain the walls. Castings made in the floor adjacent to other holes or to pits which have not been filled in and rammed firmly are subject to such a contingency and as some foundrymen know to their cost castings actually have been lost on this account by the metal bursting through the intervening wall. In the rigging under consideration there is no such danger.

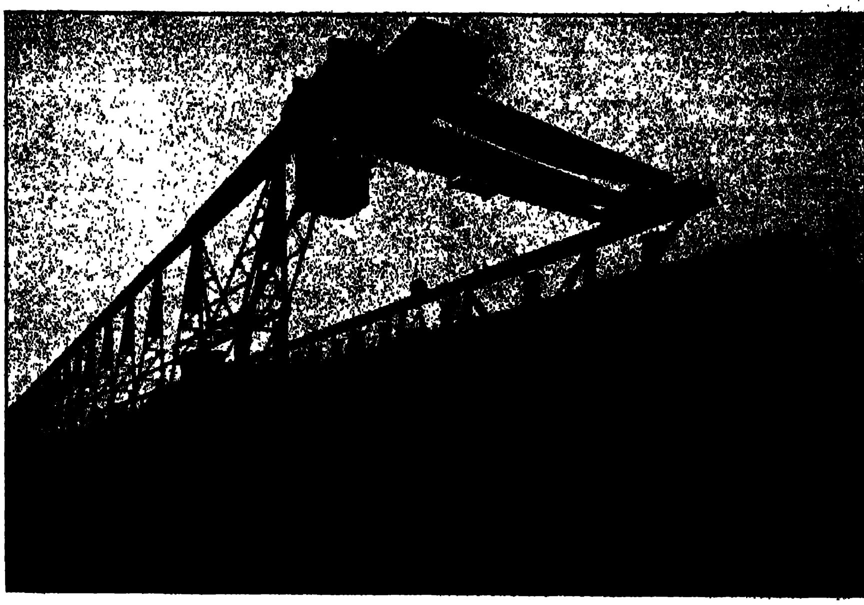


FIG. 10—AN EXTENSION OF THE CRANE RUNWAY FACILITATES UNLOADING PIG IRON AND COKE DIRECT FROM THE CARS TO THE STORAGE PILES—A MAGNET IS EMPLOYED FOR HANDLING THE PIG IRON AND A CLAM SHELL BUCKET IS USED FOR THE COKE

Copes Formed With Cores

The copes on all of the jobs made in the pit are held down by cast iron weights which rest on long iron binders extending from side to side of the pit. In the illustration, Fig. 4, it will be observed that no cope has been used. This casting is a section of a 72-inch open-side planer bed which has been cast in the position shown. The cleaned casting is shown in Fig. 3 and the many longitudinal and transverse ribs may be noted. The lower face of the casting is a continuous plate and therefore it is necessary either to support the cores which go to form the ribs on chaplets or suspend them from the cope. The method illustrated here is in general use in the foundries devoted to the production of machine tool castings. In Fig. 5 may be seen the core box on the plate with the core rammed in it, and at A in the right background is one of the cores which has been dried and turned up on its edge. It will be noted that as the core is made on its side an open frame core box is all that is necessary. These cores are provided with cast iron arbors and also with hooks by which they may be picked up and lowered into the mold.

When ramming the drag of the mold, suitable bearings are rammed up at the sides to come flush with the joint and serve as supports to sustain the weight of the cover cores. In some cases, after the cores are all placed, a cope is rammed on top of them and the weights placed on the cope. At other times flat plates are laid on top of the cores; and again the cores are wedged directly from the binder bars which carry the weights.

The grab bucket shown in the illustration, Fig. 7, is used for digging the sand out of the pit before starting a job and it also is used for filling the pit up again after the pattern has been properly set up and ready for ramming. In fact it is one of the most extensively used pieces of equipment in the shop. It is used for filling all the large flasks on the molding floor and the coremakers also use it for filling some of the large coreboxes.

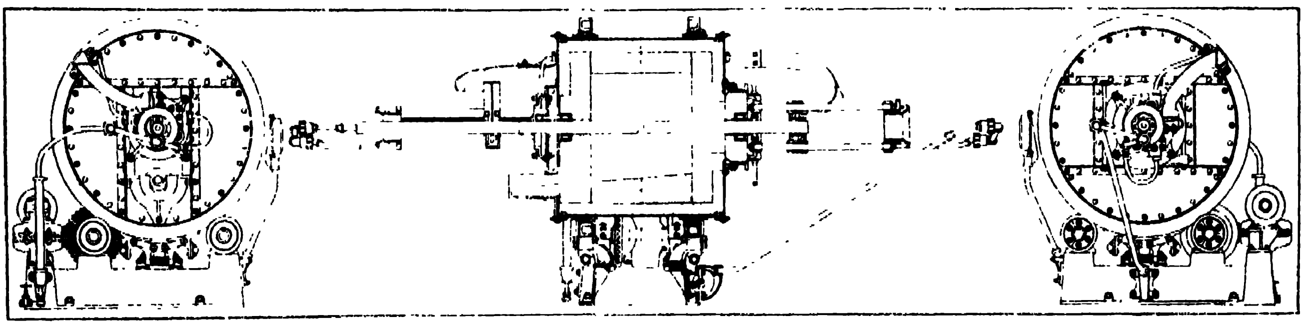
FIG. 8—CHARGING FLOOR—NOTE THE ORDERLY ARRANGEMENT OF ALL THE MATERIALS ALSO THE CANS FOR MEASURING THE COKE

Cores Made on Planed Plates

Two gas fired ovens, each 12 x 24 x 8 feet, supplied by the Ohio Blower Co., Cleveland, are used for drying the large cores while a small coke fired Stevens oven is employed in a similar capacity for the smaller cores. The bodies of the core cars are made of channels bolted together but the top of each car is covered by a large, heavy, cast-iron plate which has been planed perfectly true. Many of the coreboxes are only frames open top and bottom and can be set directly on the plate and rammed full of sand in

that position. It then only is necessary to rap the box and remove it, a procedure which does away with clamping a plate on the box, rolling it over, lifting the whole thing onto the car and then removing the box. The latter method cannot be avoided in some cases owing to the peculiar formation of the core. Under such circumstances plates are clamped onto the box in the usual way.

The tracks from the large ovens extend into the main bay and therefore all the large cores are made either on the cars or on the floor in that vicinity. The small cores are made in an adjacent portion of the side bay. This part of the building also houses the sand mixing machinery consisting of a grinding pan supplied by the National Engineering Co., Chicago, and a revolving mixer made by the American Foundry Equipment Co., New York. A supply of sand is kept in large bins at this end of the building. Core sand and facing sand are mixed in considerable quantities and stored in bins near the mixers. The prepared sand is taken from the bins either by the grab bucket or by wheelbarrow and taken to its destination.



GENERAL ASSEMBLY DRAWING OF THE BOOTH ROTATING ELECTRIC FURNACE

As already stated, the cupolas and their accessories occupy the center section of the side bay, 100 x 30 feet. The two cupolas at present in use were supplied by the Whiting Foundry Equipment Co., Harvey, Ill., and are lined respectively to 45 and 54 inches. The blast is supplied by a positive pressure blower which delivers approximately 6600 cubic feet of air a minute. It was made by the P. H. & F. M. Roots Co., Connersville, Ind., and is driven by a 40-horsepower motor. The blower, motors and the compressors which supply the air for the pneumatic tools, etc., are situated on one part of the mezzanine floor. The other end of the floor has been partitioned off and provided with shelves to serve as a store room for chaplets and miscellaneous foundry supplies.

The pig iron and coke storage yard measures 50 x 370 feet and is spanned by a 10-ton electric traveling crane made by the Northern Engineering Works. As may be seen by referring to the illustration Fig. 7, one end of the crane runway extends over the railroad track. By this arrangement the craneman can unload the material directly from the cars to the yard, handling the pig iron with a magnet and the sand and coke with a clam shell bucket. Cars of sand are spotted in front of the rolling doors shown in the end of the building in the same illustration and the sand is shoveled into a series of bins on the inside.

The flask yard lies between the foundry and the new machine shop. It is 45 x 340 feet and is served by a 10-ton Northern crane.

When designing the new building, the comfort and convenience of the employes was not forgotten. A well equipped locker, toilet and wash room has been provided in which every man has an individual locker in which to keep his clothes. The wash basins are supplied with hot and cold water. Three large heaters made by Robert Gordon, Inc., Chicago, are used for heating the shop in cold weather.

Cites Later Type Furnace

By C. H. Booth

We have read with interest the serial articles by H. W. Gillett, of the bureau of mines, entitled "Electrical Melting of Alloys." The information furnished by Dr. Gillett is of great service to the industry, and undoubtedly appreciated by all melters of brass, and those of us who are especially interested in the development of the electric furnace for this purpose.

In article No. 6, appearing in the issue of May 15, a mistake which occurs on page 404, in that the reading headings under Figs. 7 and 8 were transposed; in other words, the line drawing showing the general assembly for the Booth rotating brass furnace was wrongfully given as the general assembly of the Detroit rocking brass furnace. Herewith is shown a revised general assembly drawing of the Booth rotating electric furnace, since the drawing shown in the issue mentioned was that of the first experimental furnace, whereas the drawing attached shows the improved design, complete in all respects.

On page 402 Dr. Gillett in discussing the Detroit furnace, calls attention to the importance where copper is to be melted following a heat of 60-40 yellow brass, of running a suitable wash heat in between the two. With the Booth furnace, by having an extra furnace shell available, it has proved to be a great advantage simply to remove the shell which has been used for melting one grade of material, and to substitute the extra shell when it is necessary to have absolutely no contamination with the metal from one heat to the other. This change can quickly be made. The shell which has been in use simply is lifted off the rollers, and a new shell set in place. In order to save time the new shell can be heated previously by an oil flame so that it is brought up to working temperature before charging.

We are especially interested in comparative records as given in Dr. Gillett's article. One of the recent installations of the 500-pound Booth furnace at the plant of the National Bronze & Aluminum Foundry Co., Cleveland, showed a total output of 3800 pounds of red brass in nine hours, and an average power consumption of 310 kilowatt hour per net ton, including preliminary heating.

The first Booth furnace, which has been in operation for over a year at the plant of Leitelt Bros., Chicago, has not been shut down due to furnace repairs more than two days during the entire period. On two different occasions new linings were installed, but it only took a day's time to reline, since the furnace linings come in only three of four pieces. The first lining lasted 550 heats, and the second lining 660 heats. In both cases no patching was done to the lining in any way.

The Brown Hoisting Machinery Co., Cleveland, has purchased control of the Elyria Foundry Co., at Elyria, O.

Metallurgical Theories Conflict

Complete Bibliography Shows That Investigators Attribute Various Effects to Sulphur and Phosphorus in Steel and Cast Iron—Results Modified by Other Elements

THE joint committee of the several technical societies which is investigating the effect of phosphorus and sulphur in steel has started its work by compiling a complete bibliography on the subject. In presenting the bibliography the committee on statistics calls attention to the fact that nearly all foreign specifications allow a higher phosphorus and sulphur content in steel than is permitted in specifications originating in the United States.

Analyzing the various opinions expressed in the papers reviewed the committee states that it appears although sulphur itself may be a detriment to iron if it exists as iron sulphide, its injurious effect may be neutralized by the presence of sufficient manganese to form manganese sulphide. This compound is said to be comparatively harmless unless it occurs in a segregated form.

Phosphorus is not believed to have decidedly detrimental effects in making steel brittle if the carbon content is low, although an increase of carbon content increases the hardness when both carbon and phosphorus are high and the steel is rendered brittle. Its effect also seems to be modified by the presence of other elements contained in steel. The form in which phosphorus is present also is said to have an effect on the properties of the steel. Stead's investigations lead him to believe that while Mn_3P_2 does exert a powerful influence on the mechanical properties of steel, the phosphide, if well distributed in the ground-mass, is practically without effect.

It also seems to be a generally accepted view of the various writers that these elements are the cause of segregation and hence of unsound steel. Therefore to reduce segregation the content of sulphur and phosphorus should be kept low.

The influence of sulphur and phosphorus on steel has been investigated by many writers in an attempt to correlate the chemical constitution with the physical properties. In general, it has been found that an increase of phosphorus causes an increase in the proportional limit of elasticity and of the ultimate tensile strength; it reduces the percentage elongation and reduction of area, and increases hardness, but when high phosphorus is accompanied by high carbon, a decided brittleness results. The influence of sulphur on these properties is not so pronounced as that of phosphorus although it is generally held not to weaken steel in regard to tensile strength.

Opinion Not Unanimous

Showing that it is not the unanimous opinion of metallurgists that sulphur and phosphorus are injurious, Wasum is quoted as considering 0.10 per cent phosphorus to be harmless, and asserting that 0.15 per cent sulphur is the lowest limit at which red shortness may be expected. Miller, while he believes phosphorus to be injurious considers that sulphur below 0.20 per cent is not detrimental to the quality of the steel. Blow holes which are so often attributed to the action of sulphur, according to Pitman, are due to poor methods of pouring rather than to the sulphur content, while Stead says that sulphur may be regarded as a friend when used intelligently.

The committee calls attention to the fact, that notwithstanding the large number of tests published and listed in the bibliography, the real difference in serviceable properties of two steels that vary for example, by 0.01 per cent phosphorus, is unknown except perhaps in regard to tensile strength. Many articles, it is said, give only the author's views, beliefs or opinions which were formed from limited observations or preconceived ideas. Comprehensive series of tests will be made by the several committees working on this problem to determine conclusively the effects of these two elements on steel.

The section of the bibliography which pertains to the effect of sulphur and phosphorus on gray iron and on malleable is given herewith. From this it will be seen that opinions differ to quite an extent. This subject well could be as thoroughly studied by foundrymen as the effect of these elements on steel is being studied by this committee. The following list has been arranged alphabetically by authors:

ADAMSON, E. Pig Irons and Their Use. *Iron and Coal Trade Review*, 78, p. 302, 1909. Classifies the various pig irons and briefly considers the effect of carbon, silicon, sulphur, phosphorus and manganese on the tests and grading. Sulphur is not such a deadly enemy as it is often reported to be. Phosphorus retards the rate of cooling at the recalescence points and also lowers the strength of cast iron in transverse test.

ADAMSON, E. Influence of Silicon, Phosphorus, Manganese and Aluminum on the Chill in Cast Iron. *Journal of Iron and Steel Institute*, 69, p. 75, 1906 -I. Describes experiments made to determine the influence of these metalloids on chill, and to obtain comparative data on mechanical tests and other conditions. Phosphorus has some influence in reducing the percentage of combined carbon, and decreases the strength in transverse and deflection tests.

ARNOLD, J. O. The Physical Influence of Elements on Iron. *Journal of Iron and Steel Institute*, *45*, p 107, 1894. An investigation of the influence of the elements on the recalescent points showing that the influence is not governed by any periodic law.

BELL, I. LOUTHIAN. On the behavior of phosphorus and sulphur in the blast furnace. *Journal of Iron and Steel Institute*, *2*, p. 277, 1871. Says that the undoubted evil produced by the presence of phosphorus or sulphur in iron confers an interest upon any fact connected with their action in a blast furnace.

BELL, I L. On some of the conditions which apparently affect the quality of the iron. *Journal of Iron and Steel Institute*, *2*, p. 288, 1871. Infers the *richness* of iron is, within limits, entirely independent of its chemical composition. However, it is generally thought that an excess of sulphur hardens iron.

BLACKWOOD, P. F. Iron and Its Properties. American Foundrymen's association, Trans, *23*, p. 358, 1914. Deals with the principal properties of cast iron and its behavior when alloyed with certain other elements. He also discusses the influence of sulphur, phosphorus, manganese, aluminum and copper on molten cast iron. The red shortness caused by sulphur is due to the absence of a sufficient amount of manganese to form manganese sulphide which reduces the melting point, leaving iron sulphide present in the metal. Phosphorus produces brittleness under shock. It is also a cause of segregation and therefore of porosity. Phosphorus exerts no influence on the carbon in steel.

CARNOT, A., and GOUTAL, E Notes on the Chemical Composition of Cast Iron and Steel. *Metallographist*, *4*, p. 286, 1901. From "Annales des Mines." An account of investigations dealing with the elements. Chemical

CARPENTER, H C. H. The Growth of Cast Irons After Repeated Heatings. *Iron and Coal Trades Review*, 82, p 751, 1911. Considers the effect of sulphur, phosphorus and manganese, and gives result of experiments to find a commercial alloy whose growth is negligible. Phosphide iron grows relatively slowly while sulphur has no appreciable effect.

CHEEVER, B. W Two Conditions of Phosphorus in Iron Trans. A. I. M. E., *16*, p. 269, 1887. Concludes phosphorus exists in iron in at least two conditions, as phosphide and as phosphate and that the phosphide is the injurious condition; the phosphate being present in the form of slag. The iron should be so produced as to have as much as possible of its phosphorus oxidized to phosphoric acid.

COE, H. J. The influence of phosphorus on cast iron. Staffordshire Iron and Steel institute, *29*, 1914.

COE, H. I. The Influence of the Metalloids on the Properties of Cast Iron. *Journal of Iron and Steel Institute*, 87, p. 361, 1913. Sulphur increases the strength in a remarkable manner. There is no evidence that high sulphur content results in the formation of blow holes. Phosphorus affects the chilling action of the sand on irons low in silicon. One-tenth per cent appears to strengthen cast iron but 0.2 per cent results in a hard weak brittle material.

COE, H. I. The Influence of Sulphur on Cast Iron. *Mechanical Engineering*, *30*, p. 219, 1912. Briefly considers the reasons for the presence of sulphur in cast iron, its effect on the physical and mechanical properties, the elimination, etc. Resume of Stead's and Levy's work.

D'AMICO, E. Über den Einfluss des Phosphors auf die Eigenschaften des Flusseisens. *Ferrum*, *10*, p. 280, 1912. The increase of 0.10 per cent

phosphorus up to 0.41 per cent affected the quality to the degree as follows: The elastic limit is raised 5200 pounds; the ultimate tensile strength is raised 9200 pounds; the elongation is reduced 1.36 per cent; the contraction of area is reduced 3.81 per cent. Brinell hardness number is increased 12 points.

DILLNER, G. Roheisen fur das Werfen. *Oesterreichische Zeitschrift fur Berg und Huttenwesen*, *50*, p. 670. Sulphur makes cast iron hard, white and porous, causing absorption of gases given up on cooling and it should never exceed 0.075 per cent.

EAKINS, E. E. The Chemistry of Cast Iron. *Iron Trade Review*, *46*, p. 1030, 1910. *Iron Age*, *85*, p. 116, 1910. Discusses heat treatment and the influence of chemical compounds upon the casting. Phosphorus has no effect on the contraction of cast iron except mechanically in enlarging the eutectic mixture. The effect of sulphur depends on the amount of manganese present. In the absence of manganese, sulphur in iron promotes contraction during cooling.

EVANS, G. S. Introducing Phosphorus into Cast Iron. FOUNDRY, *44*, p. 315, 1916. Phosphorus may be introduced in cast iron to affect its fluidity but it is doubted whether it is commercially feasible.

GREENE, A. I. Electric Heating and the Removal of Phosphorus From Iron. American Institute Mining Engineers, Bulletin, Feb., 1913. Explains the metallurgical reactions by which phosphorus can be removed from iron.

HAILSTONE, G. Action of Metalloids on and the Microstructure of Foundry Irons. Proc S Staffordshire Iron and Steel Institute, 1907. Sulphur makes iron more fusible and liquid by formation of fluid sulphides; tends to form combined carbon, hardens the iron and produces greater shrinkage; causes blow holes, with high temperature of casting; promotes formation of deep chill, segregation and blow hole.

HATFIELD, W. H. The Constitution of Cast Iron. FOUNDRY, *40*, p. 326, 1912. Dealing with the constituents of cast iron, and some of the changes produced with heat treatment.

HENDERSON, JOSEPH. Note on the Distribution of Sulphur in Metal Ingot Molds. *Journal of Iron and Steel Institute*, *1*, p. 286, 1907 Finds the sulphur much higher in the top inch from such molds. Recommends taking chemical analysis samples from the bottom

HENNING, CAPTAIN. Foundry Iron. *Journal of American Foundrymen's Association*, *9*, p. 121, 1901. Showing that chemical and physical investigations are of value to the foundry industry and equally necessary at the blast furnace.

HIORNS, A. H. Influence of Chemical Compounds on the Properties of Cast Iron. *Mechanical Engineering*, *24*, p. 170, 1909. Considers the influence of the usual elements found in cast iron.

HOUGHTON, L. Some notes on the chemistry of cast iron. *Iron Trade Review*, *39*, 4, 1906. Considers carbon, silicon, manganese, sulphur and phosphorus.

HOWE, H. M. The Constitution of Cast Iron, with remarks on current opinion concerning it. Transactions of American Institute of Mining Engineers, *31*, p. 318, 1901. *Metallographist*, *6*, p. 203, 1903. *Engineering and Mining Journal*, *96*, p. 511, 1913. An attempt to select the most probable working hypotheses, in studying the relation between the chemical compositions and physical properties.

HOWSON, R. The Art of Puddling. *Journal of Iron and Steel Institute*, p. 575, 1878. Discusses quality of pig iron best adapted for puddling to remove the phosphorus. This is easiest removed from pig low in silicon.

HUDSON, W. J. Behavior of sulphur in the manufacture of iron. Abstract. *Journal of Iron and Steel Institute*, *1*, p. 213, 1880. The effect of sulphur on castings is to cause frequent fracturing while the iron is in a half-solid condition.

JOHNSON, G. R. The Action of Metalloids on Cast Iron. Industries and Iron, *25*, p. 208, 1898. Discusses the effect of each element on the properties of the iron and on the state of the other metalloids. Gives tables of tensile tests in which each element in turn is varied, the others being held constant. Ultimate tensile strength increased as sulphur increased but decreased when phosphorus increased.

JOHNSON, J. E., JR. The influence on quality of cast iron exerted by oxygen, nitrogen and some other elements. American Institute of Mining Engineers, Bulletin, *85*, p. 1, 1914. Transactions of American Institute of Mining Engineers, *35*, p. 212, 1914. Presents facts with proofs that seem to establish them. Phosphorus up to 0.50 per cent or more exercises a beneficial influence on the strength of the iron and the depth and character of the chill. It also has the tendency to reduce total carbon.

JOHNSON, J. E., JR. The Chemistry and Physics of Cast Iron in the Light of Recent Knowledge. *American Machinist*, *26*, 1903. A review of the advance made during the last three years, mentioning some important articles dealing with this subject.

JOHNSON, J. E. The Chemistry and Physics of Cast Iron. Briefly Considered. *American Machinist*, *23*, p. 316, 1900. Furnishes information from the large experience of the author.

KEEP, W. J. Cast Iron, a Record of Original Research. J. Wiley & Sons, p. 82, 1902. Depth of chill is uninfluenced by sulphur. No relation between sulphur content and the strength of iron. No indications of evil results from the highest sulphur in the series. Sulphur is, however, in no way beneficial.

NIGHT, S. S Sulphur in Iron. FOUNDRY, Jan., 1897. Some remarks on the harmful results of too large quantities of sulphur.

KREUZPOINTNER. Discussion. The Chemistry and Physics of Cast Iron. *Journal Franklin Institute*, *150*, p. 329, 460, 1900. Discussion of a paper entitled "Riddles Wrought in Iron and Steel."

LEBER, E. Schwefel in Gusseisen. *Stahl und Eisen*, *35*, p. 877, 1915. Reviews the work of Coe and others, showing tables of relations between sulphur content and such properties as hardness, ductility, etc.

LECHATELIER, M. M., and ZIEGLER. Sulfure de Fer. *Bulletin le Societe d'Encour*, 1902. *Metallographist*, *6*, p. 19, 1903. A study of the state in which sulphide of iron exists in cast iron, and the nature of its influence on the metal.

LONGMUIR, P. Cast Iron. *Journal of American Foundrymen's Association*, *11*, p. 61, 1902. Reviews the constituent elements and their effect on the quality and the purpose to which the iron is adapted.

McDOWELL, M. Practical Value of the Various Metalloids in Cast Iron. *Iron Age*, *58*, p. 161, 1896. Results of researches and experiments, followed by discussion. Estimates one part of sulphur neutralizes 10 of silicon

MAULAND, T. Influence of Sulphur in Soft Gray Iron. Transactions of the American Foundrymen's association, *26*, p. 552, 1918. Sulphur considered detrimental though castings containing up to 0.12 per cent sulphur will sometimes be good, strong and soft. At other times castings are hard with less than 0.09 per cent sulphur. Hence, sulphur is not the determining factor in hardness. His results seem to show sulphur is not as detrimental as it is usually represented to be.

MAULAND, T. High Sulphur Is Not so Bad as It Is Painted. FOUNDRY, *46*, p. 84, 1918. On the relation of sulphur to hardness in cast iron.

MESSERSCHMITT, A. Uberdie Schwefelverteilung in Gusstucken und deren Einfluss auf den Werkzeugmachinenguss. *Stahl und Eisen*, *25*, p. 894, 1905. Discusses the difference in sulphur distribution in a casting, when poured from above or from below.

MOLDENKE, R. Cast Iron. *Railroad Gazette*, *31*, p. 171, 1899. Considers chemical properties, the making of tests, etc.

PARDUN, C. Ueber das Verhalten des Schwefel beim Kupolofen-schmelzen. *Stahl und Eisen*, *31*, p. 665, 1911. A large amount of sulphur in the coke passes over to the iron first melted. It is nearly impossible to prevent this but the addition of manganese may aid.

PEARSE, J. B. Iron and Carbon, Mechanically and Chemically Considered. Transactions of the American Institute of Mining Engineers, *4*, p. 157, 1875. Gives tensile test results and chemical analyses of cast iron guns. Phosphorus decreases the tenacity.

PORTER, J. J. Influence of Various Elements on the Properties of Cast Iron. Transactions of American Foundrymen's association, *19*, p. *35*, 1911. *Iron Trade Review*, *49*, p. 839, 1911. *Iron Age*, 88, p. 1077, 1911. The chief factors which influence fluidity are the sulphur and phosphorus percentages, absence of dissolved oxide, and height of temperature to which the iron is heated above melting point.

PORTER, J. J. The Physical Properties of Cast Iron. *Iron Age*, *88*, p. 1077, 1911. Sulphur, if not in oxy-sulphide form, may not be bad for cast iron.

RHEAD, G. L. Segregation in Castings. *Ironmonger*, *138*, p. 314. Phosphorus is the most fusible element in iron and consequently lowers the melting point of iron more than any other substance contained by the iron. The brittleness of phosphoric iron when cold, unfits the castings for heavy machinery.

ROSENHAIN, W. The Distribution of Phosphorus in Cast Iron. *Met. and Chem. Engineering*, *12*, p. 650, 1914. Describes method of etching to show the presence of phosphorus in cast iron.

SCOTT, W. G. Effects of Variations in the Constituents of Cast Iron. FOUNDRY, Sept., 1902. Describing the influence of metalloids on cast iron as observed under practical conditions without reference to theory.

STADELER, A. Zur Metallurgie des Gusseisens. *Stahl und Eisen*, *31*, p. 983, 1084, 1916. Reviews the work of Ledebur, Keep, Wust and others on the influence of the various elements on cast iron.

STEAD, J. E. The Effect of Sulphur and Silicon on Cast Iron. *Nature*, *84*, p. 302, 1910. Discusses the effect of these substances on the carbon content of commercial cast iron from the metallurgical point of view.

TURNER, T. Silicon and Sulphur in Cast Iron. *Journal of Iron and Steel Institute*, *1*, p. 28, 1888. On the mutual interaction of silicon and sulphur. It appears probable that with a certain percentage of silicon there is a definite amount of sulphur which cannot be exceeded under given furnace conditions. In a blast furnace, a low temperature favors the union of sulphur and iron. The composition of the slag influences the sulphur content.

G. R. W. Effect of Sulphur in Cast Iron. *Iron Age*, *96*, p. 1551, 1915. Quotes from Prof. E. Legur's article in *Stahl und Eisen*, Jungst in "Contributions to the Investigation of Cast Iron" and Coe in the *Journal of Iron and Steel Institute*, to show the effect of sulphur depends upon presence of carbon and silicon. Data.

WEST, T. D. Characteristics of the Chemical Properties of Cast Iron. Sib. *Journal of Engineering*, 1901. Shows the utility of chemical analyses and discusses the effects of treatment and composition.

WEST, T. D. Effects of Expansion on the Shrinkage and Contraction of Iron Castings. Transactions of the American Institute of Mining Engineers, *26*, p. 165, 1896. Tests show sulphur is harmful in cast iron; 0.20 per cent sulphur being enough to injure or ruin almost any casting.

WEST, T. D. Diffusion and Segregation of Metalloids at the Furnace and Foundry. *Industries and Iron*, *19*, p. 502, 1895. Methods of lessening their evil effects. Variation in composition is discussed.

WUST, F., and MINY, J. Uber den Einfluss des Schwefels auf die mechanischen Eigenschaften des grauen Gusseisens. *Ferum*, *14*, p. 113, 1917. The action of sulphur is dependent upon the manganese content but not on the silicon content. High sulphur castings show no more proneness to porosity than do low sulphur castings. Hardness rises with increasing sulphur.

WUST, F. and STOTZ, R. Uber den Einfluss des Phosphor die mechanischen Eigenschaften des graven Gusseisens. *Ferrum*, *12*, p. 89, 1914-15. Investigation of the influence of phosphorus on gray cast iron. Test bars with various percentages of phosphorus were prepared. The transverse test gave a mean breaking strength from 39.60 kilograms per square millimeter for 0.16 per cent phosphorus down to 25.80 with 2.04 per cent phosphorus. The hardness at the same time increased from 234 (Brinell) to 327.

WUST, F. Uber die Abhangigkeit der Graphitausscheidung von der Anwesenheit fremder Elemente in Roheisen. *Metallurgie*, *3*, p. 200, 1906. The solubility of carbon in iron is lessened by sulphur, but sulphur does not promote its conversion to temper carbon;" on the contrary, it neutralized the action of silicon in this respect.

Malleable Cast Iron

DAVIS, P. H. Effects of Phosphorus on Malleable Cast Iron. FOUNDRY, *47*, p. 258, 1919. Discussion of Mr. Teng's and Professor Touceda's paper on this subject.

HEMENWAY, H. Calculating Mixtures for Malleable Cast Iron. American Foundrymen's association, transactions, *21*, p. 413, 1915. Phosphorus in connection with silicon has an influence on the fluidity of iron. There will be no bad effect if the amount of phosphorus present does not exceed 0.20 per cent. There are no beneficial results arising from the presence of sulphur and it should be less than 0.045 per cent.

MERRICK, A. W. Sulphur Reduced in Malleable Iron. FOUNDRY, *47*, p. 685, 1919. Finds slag lowers sulphur.

SMITH, R. H. Sulphur in Malleable Cast Iron. *Journal of Iron and Steel Institute*, *92*, p. 141, 1915. *Iron Age*, *96*, p. 1235, 1915. Research to ascertain if sulphur is removed by annealing and what conditions favor removal. Sulphur does not appear to have any markedly injurious effects on the product until about 0.15 per cent is present. Higher percentages give unsatisfactory bending tests and low deflections.

TENG, J. H. Phosphorus in Malleable Cast Iron. *Journal of Iron and Steel Institute*, *98*, p. 349, 1918. Investigations undertaken to determine the effect of proportions of phosphorus

(Concluded on page 495)

Rigging Heavy Repetition Work

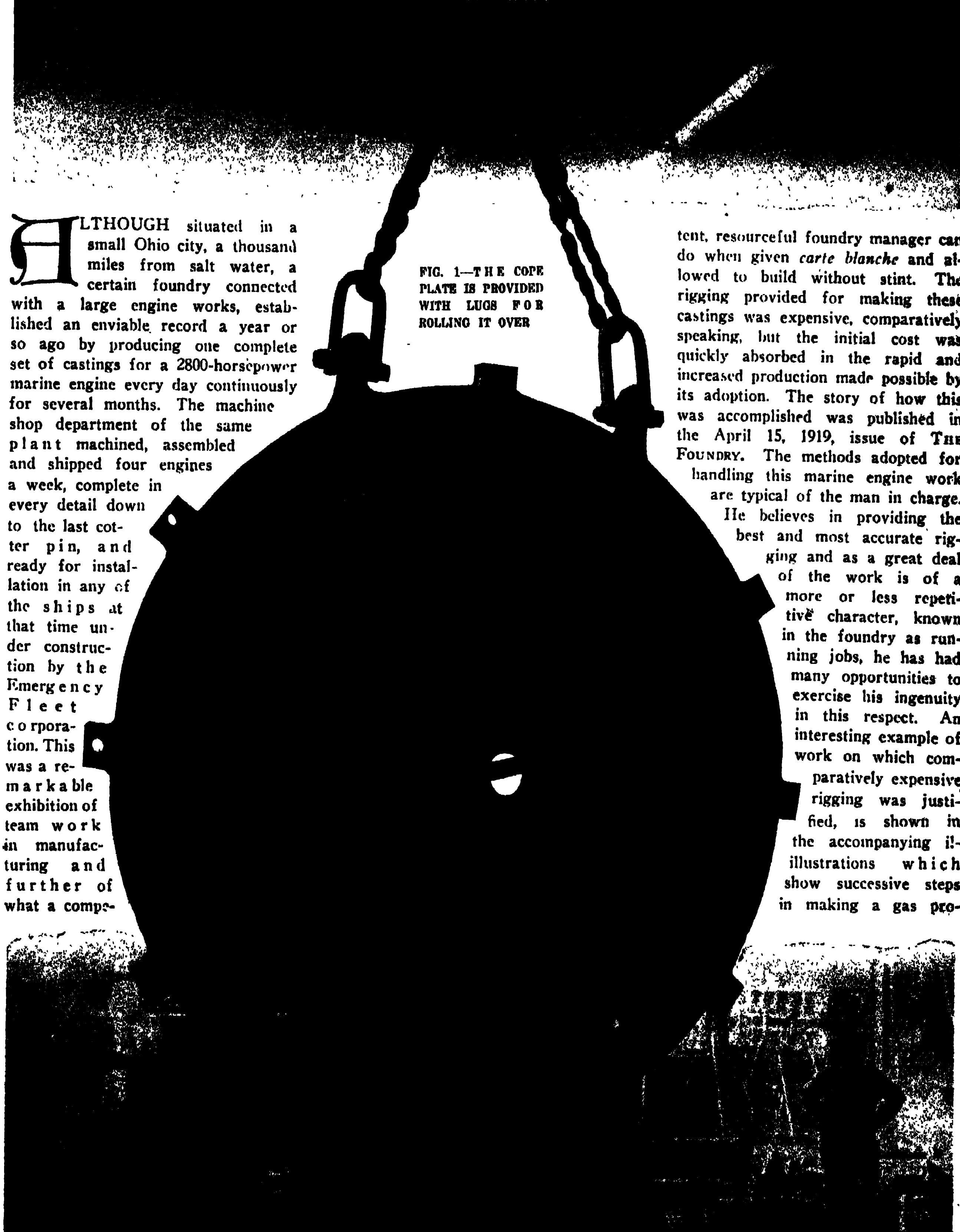


FIG. 1—THE COPE PLATE IS PROVIDED WITH LUGS FOR ROLLING IT OVER

ALTHOUGH situated in a small Ohio city, a thousand miles from salt water, a certain foundry connected with a large engine works, established an enviable record a year or so ago by producing one complete set of castings for a 2800-horsepower marine engine every day continuously for several months. The machine shop department of the same plant machined, assembled and shipped four engines a week, complete in every detail down to the last cotter pin, and ready for installation in any of the ships at that time under construction by the Emergency Fleet corporation. This was a remarkable exhibition of team work in manufacturing and further of what a competent, resourceful foundry manager can do when given *carte blanche* and allowed to build without stint. The rigging provided for making these castings was expensive, comparatively speaking, but the initial cost was quickly absorbed in the rapid and increased production made possible by its adoption. The story of how this was accomplished was published in the April 15, 1919, issue of THE FOUNDRY. The methods adopted for handling this marine engine work are typical of the man in charge. He believes in providing the best and most accurate rigging and as a great deal of the work is of a more or less repetitive character, known in the foundry as running jobs, he has had many opportunities to exercise his ingenuity in this respect. An interesting example of work on which comparatively expensive rigging was justified, is shown in the accompanying illustrations which show successive steps in making a gas pro-

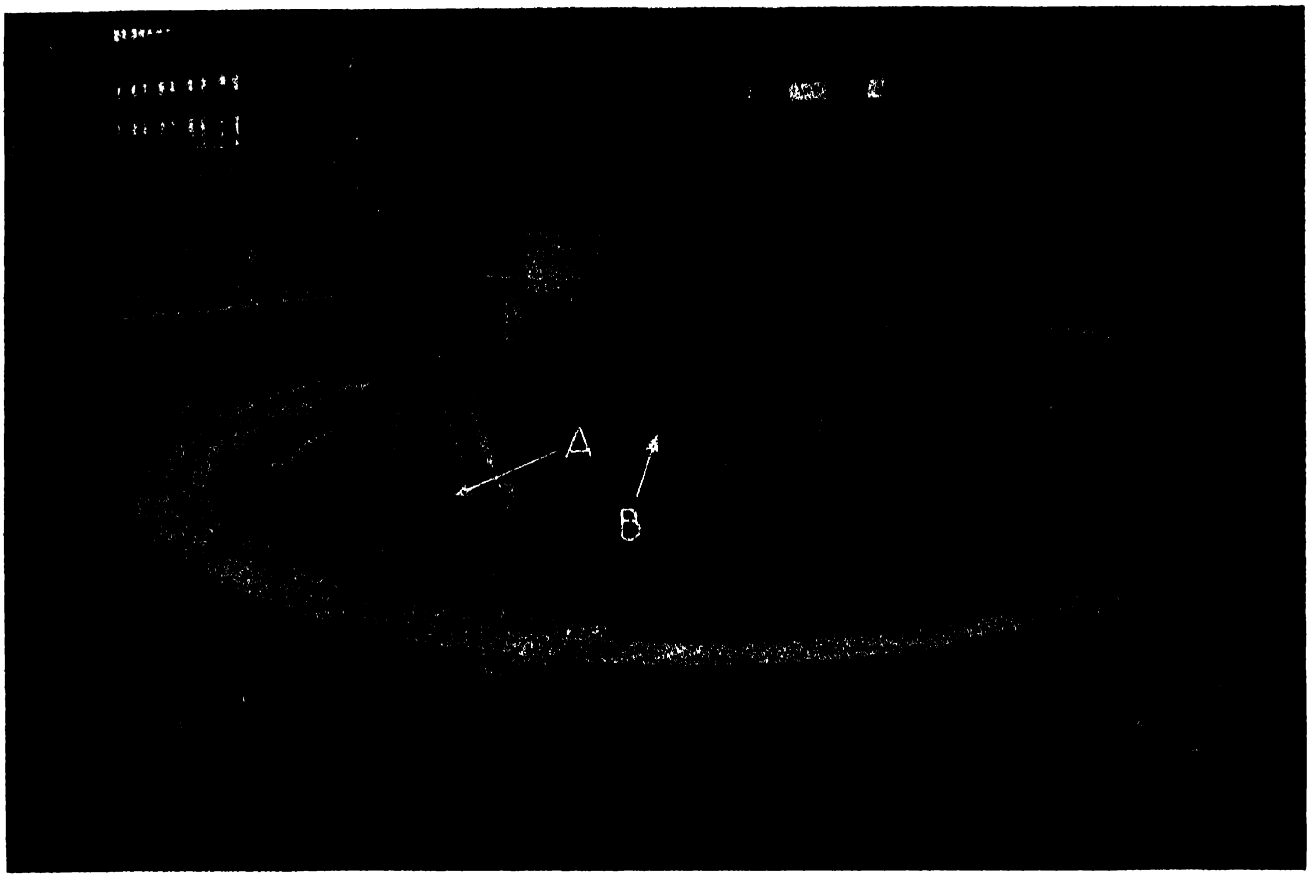


FIG. 2—DRAG PARTLY LOAMED—NOTE THE GRIDS AT *A* FOR REINFORCING THE WALL AND THE SPECIAL GUIDE PLATE ON THE SPINDLE AT *B*

ducer ash pan. This casting is approximately 12 feet in diameter by 3 feet deep in the center with a metal thickness of ⅞-inch This is a job that would take a molder a week or ten days to make under ordinary circumstances. With the aid of the rigging shown one molder casts an ash pan every second day. The first order for this job called for 90 castings and the second specified 200 so it is easily seen where the saving in time offsets the cost of the rigging.

The rigging provided for molding the job consists of a heavy circular cast iron bottom plate, 15 feet 4 inches in diameter with 12 staples cast in as many lugs distributed at equal intervals around the perimeter. These act as anchors in binding the mold together. One cast-iron flask section 14 feet 4 inches inside diameter provided with flanges top and bottom is provided. The top flange was machined to a true face and had holes drilled at diametrically opposite sides to receive the guide pins when closing the mold. On account of the casting being split in two the mold is not a true circle but has a flat space on each side. It therefore is necessary to provide means for closing the cope accurately and in the proper relative position to the drag The guide holes were drilled diametrically opposite each other on a center line; the cope, spindle bearings and other measurements were determined from the same line; and then, to insure against the possible error due to turn-

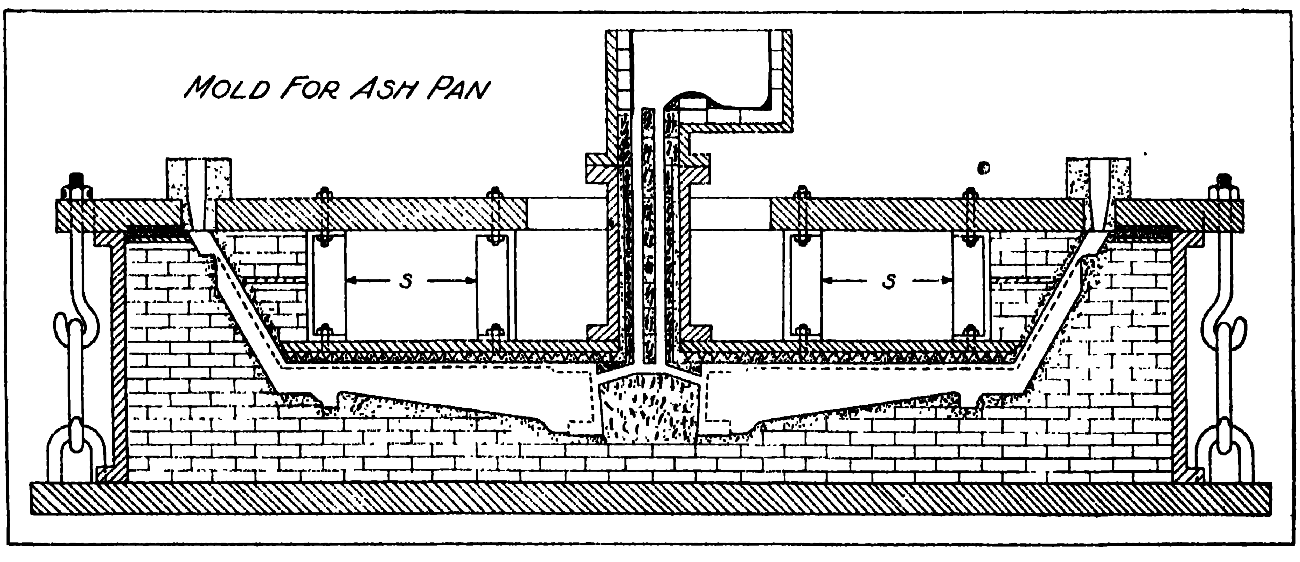


FIG. 3—SECTIONAL DRAWING SHOWING THE MOLD ASSEMBLED READY FOR POURING THE STANDARDS SHOWN AT *S-S* RENDER THE LIFTING PLATE ABSOLUTELY RIGID

ing the cope end for end, a second hole was drilled near one of the first on one side only. Thus by having two holes on one side and only one on the other there is no possibility of making an error in closing the mold.

The cope plate has the same general dimensions as the bottom plate. It is provided on opposite sides with a pair of substantial lugs in which to fasten the clevises when rolling it over. Their application together with the other general features of the plate are shown in the illustration Fig. 1. This plate is not solid but is provided with a 40 inch opening in the center which is more plainly evident in Fig. 5. This opening was found to be an aid when assembling the cope and face plates. It was designed primarily as a convenience in setting and securing the runner box which as may be seen from the illustration Fig. 3, is made up separately from the rest of the mold and afterward lowered through the central hole in the top plate until it rests on the face plate as shown in the same illustration. The prickered face plate which forms the inside bottom surface of the pan and also carries the lift is attached permanently to the cope plate by six cast-iron standards shown at *S* Fig. 3. These standards serve a double purpose. They carry the face of the mold and also prevent it from springing under the pressure of molten iron while the casting is being poured. This plate is provided with a 9-inch opening in the center to accommodate the runner core which forms a continuation of the upright runner.

As may be noted from several of the illustrations the casting is a flat bottom pan with sloping sides and reinforced on the exterior of the bottom by a number of ribs which radiate from the center. For convenience in shipping the casting is made in two halves but is poured as a unit. The joints on each side are afterward machined to a true fit, bolt holes drilled in the flanges and the pan assembled. It is then taken apart and shipped to its destination where it is again assembled and placed in position in the base of a gas producer installation.

The radial cores which form the ribs on the bottom of the pan are made on plates which have been machined absolutely flat on the face side. Instead of providing individual prints on the bottom face of the mold for each core, one large common print is provided to receive them all. All the cores are made with shoulders on the sides which determine the shape of the bottom edges of the ribs and also space them automatically. The cores which form the lugs on the sides and which also carry the prints for the side *splitting* cores are located and tucked into place with the first rough coat of loam. They in turn serve as a guide in setting the remainder of the cores after the mold has been dried and cleaned out.

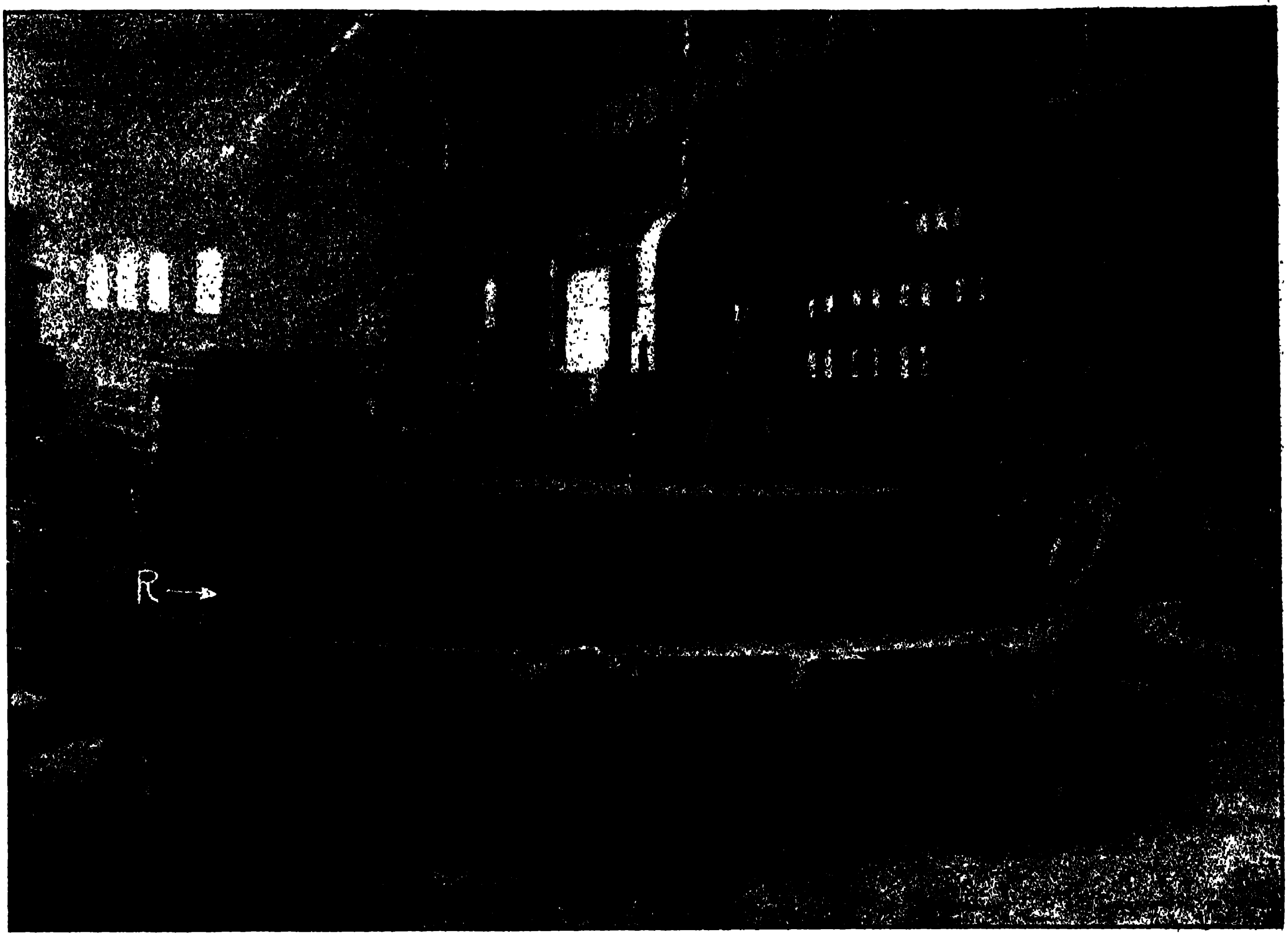


FIG. 4—COPE PARTLY LOAMED—PART OF THE COPE PLATE JOINT IS PLANED BUT THE REMAINDER IS RECESSED AND PROVIDED WITH A CHANNEL TO CARRY THE LOAM AS SHOWN AT *R*

The face of the cope plate was machined to a true face for a distance to correspond with the width of the top flange on the flask section which serves as a drag. Pin holes were drilled on a center line which coincides with the center line on the drag. In this way both halves of the mold were made independently of each other but are fitted together as closely and accurately as if one part had been built on top of the other.

In molding work of this character, where a common circumference is struck from more than one center a spindle and guide plate, similar to the

one shown in Fig. 2, is used. The spindle seat carries a square opening in which the foot of the spindle is held rigidly and prevented from revolving with the action of the arm. The guide plate *B* is attached to the spindle by a set screw. It is adjusted to the proper height after the arm and sweep have been set. The sweep is attached to the arm by four bolts which move freely in a horizontal direction in slots in the arm. The sweep is guided, in its path around the mold, by a pin on the lower edge which is held to a certain course by the groove in the guide plate. The lower arm on the sweep simply is slotted to fit the spindle. The spindle seat used on the cope is provided with three long legs which span the opening in the center of the cope plate. It has to be taken off each time the mold is assembled for pouring and put on again each time the mold is repaired. To insure that it always is set in the correct position, two of the bolt holes by which it is fastened to the cope plate are made alike but the third is much smaller and requires a different sized bolt. Thus it is readily apparent that it will fit only in one position and that is in the way in which the parts were laid out and assembled at the start. The spindle employed on the cope of course, is provided with a guide plate similar to that used on the drag and attached to the spindle in the same relative position.

FIG. 5—THE COMPLETED MOLD IS BOUND FIRMLY TOGETHER AT 12 POINTS ON THE CIRCUMFERENCE AND BY TWO BINDERS ACROSS THE CENTER

After the rigging had been prepared and tried for accuracy a large hole was dug in the foundry floor about 2 feet deep. The bottom plate was lowered into this hole and adjusted until it was approximately level. The drag section of the flask was set on next and leveled absolutely, 1-inch pieces of iron being placed between the plate and the bottom flange at the points near the anchor bolts. This was done to provide an avenue of escape for the steam generated while drying the mold and for the gas while the mold was being poured. Several short lengths of pipe were arranged in a vertical position to convey the steam and gas away from the opening between the flask and the plate and then the hole was filled with sand and rammed.

The mold was bricked up in the usual way, using the sweep for a guide. Setting the sweep was simplified as it was only necessary to let the outer extremity rest on the flange of the flask and then level the arm. After the first setting, the arm, sweep and spindle were not disturbed in relation to each other. The mold was given a rough coat of loam then a thin coat of slurry after which the crane was hooked to the spindle by a bar shoved through a hole near the top and spindle and sweep were lifted out and placed to one side until after the casting had been poured and shaken out. They then were replaced and the same procedure gone through with again.

When building the mold, the brick work is left quite open, cinders are used freely and generous vent passages provided to allow gas to escape from the cores used to form the ribs on the bottom of the pan. These cores are covered with metal on the top and on the sides and it thus is necessary to carry off the vent through the bottom of the mold. The cores are prevented from rising by a number of stud chaplets which are set on before the mold is closed. Each chaplet is the exact thickness of the metal in the bottom of the pan and therefore when the cope is closed, the lower face bears on the chaplets which in turn hold the cores in their places.

As may be seen, by referring to the illustration Fig. 3, the core which forms the circular opening in the center of the pan is provided with gates for running the casting. It also is provided with a shoulder which projects into and fills the opening left in the cope face plate for that prupose. The top of the shoulder comes flush with the inside surface of the plate and therefore when the runner box is lowered into place the bottom surface comes into intimate contact with the top of the core and forms a tight joint. The runner box is formed in two parts, the pouring basin and the upright portion. Each of these is bricked on the inside and only requires a little patching each time it is used to make it serviceable. Four risers are taken off the rim. They appear to be much heavier than necessary on a thin casting like an ash pan until it is learned that their chief purpose is to support and lift the casting from the mold at the same time the cope is lifted off.

At night after the casting has been poured the anchor bolts are removed, the crane hooked on to the lugs of the covering plate and both plate and casting lifted as one load. The casting hugs the cope tightly and with the support afforded by the four risers may be carried to a suitable point on the floor where it is lowered down and rapped loose. The casting is left lying on the floor and after the three-legged spindle seat has been bolted to the plate the latter is rolled over and set up on blocks ready for the molder to start another mold the next day.

Combination for Research Urged

That the malleable iron industry is not on as strong a footing in Great Britain as it should be was indicated in a paper presented at a recent meeting of the Coventry branch of the Institute of British Foundrymen, by F. S. Lantsberry. Manufacturers were urged to join for the purpose of spreading the knowledge of malleable now available and to carry on research work along this line. An organization for these purposes, it was said, could obtain assistance from the government which had voted a million pounds sterling, approximately $4,000,000 for industrial research.

One of the difficulties with which users of malleable are confronted is castings which do not machine readily. This was said to be due either to under annealing or to over annealing.

Under annealed castings could be softened by reannealing, but the author had found that reannealed castings were likely to be over annealed on the second anneal. The object of the anneal in making white-heart malleable is to remove the carbon and the author said that the temperature is carried to from 900 to 1000 degrees Cent.

A characteristic of white heart malleable is the large amount of sulphur which may be present without injuring the casting. This is shown by some analyses of white-heart malleable which Mr. Lantsberry gave as representing the wide range of composition in malleable iron as made by three different manufacturers. In these analyses which follow, it may be noted that the phosphorus and manganese are lower on the average than is the custom in making black-heart malleable.

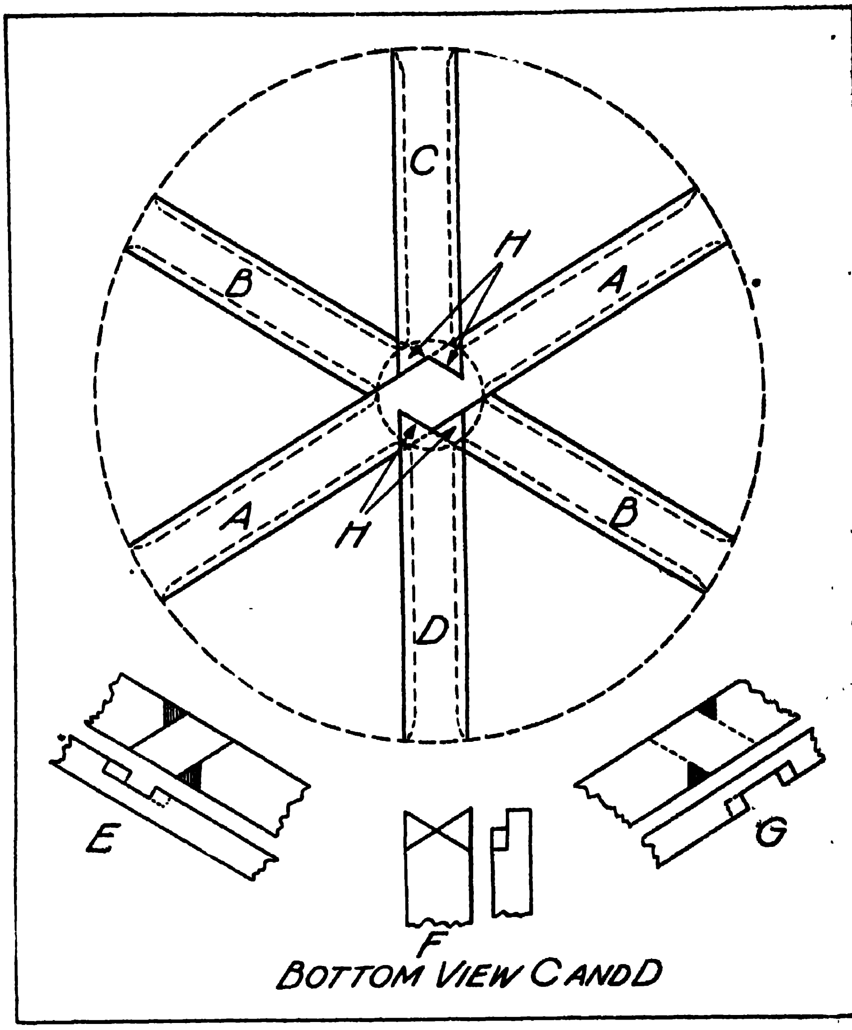
Silicon	1.12	0.74	0.78
Sulphur	0.22	0.186	0.129
Phosphorus	0.042	0.060	0.073
Manganese	0.11	0.14	0.15
Silicon	0.60	1.28	1.03
Sulphur	0.35	0.356	0.19
Phosphorus	0.056	0.075	0.058
Manganese	0.20	0.16	0.08
Silicon	0.32	0.73	1.11
Sulphur	0.17	0.38	0.137
Phosphorus	0.084	0.056	0.070
Manganese	0.07	0.52	0.15

Methods of Constructing Strong Arm Joints

By Arthur Landcrer

To provide strong and perfectly fitting joints is one of the principal aims of a good pattern maker. The shape, size and general character of the pattern determines just what style of joint is most suitable. In making the hub and arms of an ordinary wheel it is customary to cut the hub ends of the arms on radial lines and have the points all meet at the center. The hub is attached firmly and permanently to these parts and binds them together. In some cases where it is desired to use various sized hubs with the one set of arms some other method must be adopted for binding the ends of the arms together since the hubs are loose and detachable. The type of joint shown in the accompanying illustration is well adapted to this purpose.

Four pieces of stock are dressed to the required width and thickness. Two of these pieces, *AA* and *BB*, are made the full diameter of the wheel and the other two pieces, *C* and *D*, are cut to a length equal to half the diameter less half the width of the hub. *AA* and *BB* are slotted across the center, *AA* on the bottom and *BB* on the top side, as shown at *E* and *G*. They are then assembled in their proper relative position by placing them on a layout board which has been marked in a suitable manner for that purpose. It is optional whether they are glued and nailed at this time or after the remaining arms have been fitted. In either case they are tacked to the board temporarily. The triangular 60-degree pieces shown in black in *E* and *G* are checked out half way through the thickness. The inside ends of *C* and *D* are then cut to fit and also checked half way on the corresponding triangular points as shown. After all the pieces have been fitted accurately they are glued, and if considered necessary, nailed or screwed together.



IN THIS ARM JOINT, *AA* AND *BB* ARE FULL LENGTH PIECES EXTENDING FROM SIDE TO SIDE AND HALF CHECKED IN THE CENTER WHILE *C* AND *D* ARE HALF CHECKED IN AT THE ENDS AS SHOWN AT *HH*

The dotted lines indicate the stock which has to be removed to make the desired shape of the arms. This is done after the glue has set, when the assembled arms can be removed from the layout board and fastened in the vise for convenience in tooling.

The Lawrenceville Bronze Co., Pittsburgh, with a plant at Zelienople, Pa., which was reorganized about 18 months ago, has increased its furnace capacity. A special meeting of the stockholders will be held June 28, to consider an increase in the capital from $200,000 to $1,000,000.

Issues Booklet on Brass

An interesting and artistic booklet of 78 pages, printed on heavy coated paper, entitled *Seven Centuries of Brass Making* has been issued recently by the Bridgeport Brass Co., Bridgeport, Conn. It reviews briefly the history of ancient brass making and contrasts the early and even recent methods of production with the modern electric furnace process. Comprehensive descriptions, illustrated from reproductions from numerous excellent photographs, are given of the methods usually employed for casting brass, followed by the reasons which actuated the company in discarding the crucible process, tearing down the high brick stacks and installing a battery of electric furnaces for melting purposes.

The sequence of operations and the equipment necessary to convert the cast brass ingots into commercial rolled shapes, sheets, rods, wire, tubes, etc., is described at considerable length and freely illustrated. Laboratory and research departments; characteristics and structure of brass are described.

Standard Foundry Cost System—III

Plant Investment Classification Is Outlined in Section II — Depreciation Rates for Buildings and Equipment, General Ledger Accounts Are Listed—Comments Regarding Starting Cost Work

COMPILED BY
C. E. KNOEPPEL & CO., INC.
NEW YORK

AS FAR as practicable the following plant investment accounts should be carried in the general ledger, the opening entries being based on the first cost or replacement value of the investment in each class. If such value is not determinable, an appraisal of the physical property should be made. The classification is intended to provide more than an analysis of the plant investment but to afford: *First*, a means of classification for depreciation group rates; *second*, a basis for classification of maintenance charges, and *third*, a means of establishing reserves corresponding to each plant investment account.

1. Land.
2. Buildings and structures.
3. Cupolas, ovens and furnaces.
4. Piping and wiring.
5. Machinery and tools—cataloged.
6. Machinery and tools—miscellaneous.
7. Electrical equipment cataloged.
8. Electrical equipment—miscellaneous.
9. Shafting, pulleys, hangers and belting.
10. Special machinery, jigs, fixtures, punches and dies.
11. Shop fixtures and equipment—miscellaneous.
12. Railway tracks and overhead equipment.
13. Rolling stock.
14. Trucks, teams and other conveyances.
15. Patterns.
16. Metal flasks.
17. Office furniture and appliances.
18. Power plant equipment.

These accounts should be consolidated for presentation on the balance sheet and shown as one amount against plant investment. Corresponding reserves should also be consolidated on the balance sheet and shown as general reserve for plant depreciation.

If desired only two groups may be used; i. e.,

Real estate and buildings.
Machinery and equipment.

SECTION VIII
DEPRECIATION

For convenience, the schedule of depreciation rates given in first bulletin is presented in the accompanying table for what assistance it may give.

It must be borne in mind, however, that new government rulings are constantly being made and that all rulings as to depreciation should be carefully watched. As stated elsewhere in this series of articles absolute accuracy in all details is essential to success.

SECTION IX
GENERAL LEDGER ACCOUNTS

The schedule of general ledger accounts on the following pages is such as would be required to reflect the details of an average foundry. Sub-accounts or additional accounts should be added to represent classes of transaction special to any particular foundry. The schedule and definitions are merely illustrative of the principles involved.

The accounts appear under the following groups which are in the sequence required for presentation on the balance sheet and profit and loss statement.

1. Current assets.
2. Inventory assets.
3. Fixed assets.
4. Deferred assets.
5. Intangible assets.
6. Current liabilities.
7. Fixed liabilities.
8. Reserves.
9. Capital liabilities.
10. Surplus and profit and loss accounts.
11. Financial profit and loss accounts.
12. Operating expense accounts.
13. Sundry and general ledger accounts.

The following detailed accounts are suggested for the general ledger. These may be amplified as much as desired, or as the business demands.

1—*Current Assets:*

1—Cash in bank (an account for each bank).
2—Petty cash.
3—Notes receivable.
4—Accounts receivable.
5—Bonds and other investments.

2—*Inventory Assets:*

1—Melting stock metals.
2—General stores (or as many as desired).
3—Finished castings.
4—Work in process.

3—*Fixed Assets:*

1—Machinery and equipment.
2—Real estate and buildings.

4—*Deferred Assets*

1—Unexpired insurance.
2—Unexpired taxes.
3—Prepaid interest.

5—*Intangible Assets:*

1—Patents.
2—Good will.

6—*Current Liabilities:*

1—Notes payable.
2—Accounts payable.
3—Accrued payroll.
4—Accrued taxes.
5—Accrued commission.
6—Accrued interest.

7—*Fixed Liabilities:*

1—Bonds payable.
2—Mortgages payable.

8—*Reserves:*

1—Reserve for depreciation on machinery and equipment.
2—Reserve for depreciation on buildings.
3—Reserve for bad debts.

9—*Capital Liabilities:*

1—Capital stock—preferred.
2—Capital stock—common.

10—*Surplus and Profit and Loss Accounts:*

1—Surplus.
2—Income and excess profits account.
3—Dividends—preferred stock.
4—Dividends—common stock.
5—Profit and loss.
6—Adjustment account.
7—Castings sales.
8—Cost of castings sales.
9—Miscellaneous sales.
10—Cost of miscellaneous sales.
11—Freight out on sales.
12—Administrative expense.
13—Selling expense.

11—*Financial Profit and Loss Accounts:*

1—Interest received.
2—Discount taken.
3—Interest paid.
4—Discount given.
5—Interest on investments.

12—*Operating Expense Accounts:*

1—Cost of melt.
2—Cost of melt credits.
3—Molding burden—direct labor.
4—Molding burden—direct labor credits.
5—Molding burden—machine hour.
6—Molding burden—machine hour credits.
7—Molding sand cost.
8—Molding sand cost credits.
9—Flask cost.
10—Flask cost credits.
11—Coremaking burden—direct labor.
12—Coremaking burden—direct labor credits.
13—Coremaking burden—machine hour.
14—Coremaking burden—machine hour credits.
15—Finishing cost.
16—Finishing cost credits.
17—Annealing cost.
18—Annealing cost credits.
19—Power, heat and light expense.
20—Pattern shop expense.

21—General expense.
22—Expense ledger.
13—*Sundry General Ledger Accounts:*

Credits—
(1) Total amount of checks issued during the month.

Debits—
(1) With the value of checks drawn to create or to increase the

Depreciation Schedule

When a Piece of Equipment Outlives Expected Life, Establish Scrap Value and Make no Further Charge for Depreciation

A	
Alarm signal boxes	7½
Anvils	5 to 10
Arresters, lightning	10
Axes, fire	10
B	
Barrels, steel tumbling	10
Baths, shower	10
Bearings, ordinary shaft hanger, babbitt	Expense
Bearings, roller, on line shaft	10
Belts, fast running—short life belts	Expense
Belts, lacing machines	10
Belts, main and ordinary drive	5 to 20
Benches, iron	5
Benches, wood	10
Bins, steel	5
Bins, wood	10
Blackboards, attached to wall	10
Blackboards on iron standards	10
Blower exhaust, laboratory	10
Blower system, furnaces	5
Boards, directory and planning	10
Boiler, steam power	5 to 7½
Boiler tube expanders	10
Boring machine, pattern	5
Boxes, annealing	Expense
Boxes, tote, steel	20
Boxes, tote, wood	Expense
Buildings, brick	2 to 5
Buildings, brick and wood	3 to 5
Buildings, concrete, reinforced	2 to 3
Buildings, steel frame, brick walls	2 to 3
Buildings, wood	5 to 10
Bumpers (See jarring machines)	10
Burners, gas—under boiler	5 to 7½
C	
Cars, annealing furnace	10 to 20
Cars, core oven	5
Cars, foundry trucking	10
Chemical laboratory apparatus	10
Chutes, loading and unloading	10 to 25
Clocks	4 to 10
Closets, toilet	10
Clutches, friction	10
Compresses, air	7½
Controllers, elect. circuit	10
Conveyors	10 to 20
Couplings, line shaft	10
Crane track	5
Cranes, swing	7½
Cranes traveling	7½
Cupolas, steel	5
Cutters, bolt	5 to 10
Cutters, sprue	7½
Cutters, stencil	7½
Cutting apparatus, acetylene generation	10
Cutting apparatus, acetylene tools	Expense
D	
Drill presses, multiple	7½
Drill presses, ordinary	5
Drinking fountains	10
Dust collecting systems	7½
E	
Elevators	7½
Engines, steam or gas	4
Exhaust heads	5 to 10
Extractors, oil	5
F	
Fans, ventilating	7½
Feeders, boiler compound	7½
Filters, oil	5
Fire apparatus	10
Flasks, aluminum	10
Flasks, cast iron	33⅓
Flasks, snap steel	12½
Flasks, wood	Expense
Flasks, wood, snap, metal bound	20 to Expense
Forges	5
Furnace, annealing	10
Furnaces, crucible—pit	7½
Furnaces, cupola—steel	5
Furnaces, electric	5 to 7½
Furnaces, open-hearth	10
Furniture and fixtures, general	10
G	
Gages, steam recording	5
Gages, steam	10
Glassware, laboratory	Expense
Glue heaters	10
Generators, electric	5
Grinders, bench, for castings	7½
Grinders, hand air	20
Grinders, hand electric	20
Grinders, swing for castings	10
Grinders, tool	5
Guards, for machines, belts, etc	10
H	
Hangers, shaft	4
Heaters, boiler feed water	5
Heaters, foundry pot	10
Heating systems, hot air blower	6
Heating systems, steam	4
Hoists, air and hand	7½
Hoists, electric	10
Hoods, safety grinding wheel	5
Hose, air	Expense
Hose, fire	20
Hose, foundry	10
Hose, ladders, straps, etc	10
I	
Injectors, boiler	10
Instruments, engineering and drafting department	5
J	
Jackets for molds	Expense
Jacks, hand	10
Jacks, hydraulic	5
Jarring machines	10
K	
Kettles, cast iron	10
L	
Laboratory equipment, except glassware	7½
Laboratory equipment, glassware	Expense
Ladders, wood	Expense
Lanterns, fire	20
Lathes	5
Lavatories	5
Lightning arresters	10
Lockers, steel	5
M	
Machinery, general	5 to 10
Meters, electric	5
Meters, oil	7½
Meters, steam flow	10
Milling machines, according to kind	5 to 7½
Mixers, sand, Broughton type	10
Mixers, sand, Chile mill	7½
Molding machines, bench, Adams	7½
Molding machines, Berkshire	7½
Molding machines, rockover	5
Motors, electric	5
O	
Oil separators	5
Ovens, core, brick	10
Ovens, core, steel	10
Ovens, drying, brick	10
Ovens, drying, concrete	5
P	
Pans, steel tote	20
Patterns	10 to Expense
Pipe machine	5
Piping, air	5
Piping, fuel oil, overhead	5
Piping, fuel oil, underground	5 to 10
Piping, water and steam	5 to 7½
Planers, iron and wood	5
Plates, core	20 to Expense
Platforms for elevating trucks	Expense
Platforms, unloading	10
Plating machine, barrel	10
Pulleys, friction clutch	10
Pulleys, plain and split	5
Pumps, centrifugal water; if constantly used	20
Pump governors	5
Pumps, hydraulic	5
Pyrometers, thermoelectric	7½
Pumps, steam	5
NOTE:—Piping underground—life governed by use and character of protection.	
R	
Racks, iron core	5
Racks, iron for iron and steel storage	5
Racks, iron, tool and tray	5
Racks, revolving iron	10
Racks, wood	10
Regulators, feed water	5
Regulators, voltage	10
Riddles, sand, core shop	20
Rumblers, steel	7½
S	
Safety devices	10
Sand blast equipment	10
Sand mixer	See M
Saws, band, blades	Expense
Saws, band, machine	5
Saws, power	5
Scales, dormant	7½
Scales, platform	10
Sewers	2½
Shafting and hangers	4
Shapers	5
Shelving, steel	5
Shelving, wood	5 to 25
Signal boxes	7½
Sinks	10
Slip jackets and bands for molds	Expense
Sprinkler systems	3 to 7½
Sprue cutters	7½
Stacks, boiler and core ovens—steel	5 to 10
Stacks, brick	3
Stands, iron	5
Stands, wood	10
Steam separators	10
Steam traps	7½
Straightener for castings	10
Switch boards	4
T	
Tables, coremakers'	7½
Tables, wood, general	10
Tables, wood, iron covered	7½
Tanks, iron acid	15
Tanks, iron air and oil	5
Tanks, fire bucket	10 to 25
Tanks, water, cement	5
Tanks, water, iron	10
Tanks, wood	10 to 25
Testing machines, tensile	5
Tool, Stands	See S
Tools, small	4 to 50
Tractors, electric	10
Transformers, electric power	4
Trucks, barrel	25
Trucks, electric	10
Trucks, elevating	10
Trucks, iron frame, 4-wheel	10
Trucks, wood, hand	25
Trucks, wood, 4-wheel	12½
Tumbling barrels—(See rumblers)	7½
Turntables	10
V	
Valves, back pressure	5
Valves, reducing	7½
Valves, disk, brass	7½
Valves, gate, brass	5
Valves, gate, iron	10
Vises	10
W	
Welding apparatus, acetylene, generation	10
Welding apparatus, acetylene, tools	Expense
Welding apparatus, electric, generation	5
Wheel barrows	50
Wire cutters	10
Wire measuring machine	5
Wire straightener	5
Wiring and fixtures, lighting	7½ to 10

1—CURRENT ASSETS

(1-1)—*Cash in Bank:*

Debits—
(1) Open the account with the amount of cash in bank;
(2) Total amount of cash deposited during the month.

Balance—
Represents value of cash in bank at end of month. Should be reconciled with bank's statement to determine outstanding checks and uncredited deposits.

(1-2)—*Petty Cash:*

amount of cash on hand to cover petty expenses for a short period.

Credits—
(1) With any decrease in the amount on hand.

Balance—

Represents amount set aside for petty cash disbursements.

(1-3)—*Notes Receivable:*

Debits—
(1) Open the account with the face value of promissory notes and acceptances on hand;
(2) Notes and acceptances received;
(3) Notes renewed.

Credits—
(1) Payments on notes receivable and acceptances;
(2) All notes and acceptances sold or otherwise disposed of;
(3) All notes renewed.

Balance—
Represents value of all notes receivable and acceptances on hand.

(1-4)—*Accounts Receivable:*

Debits—
(1) Open the account with the total of individual customers' accounts in the accounts receivable ledger.
(2) The total charges to customers as represented by postings on sales register.

Credits—
(1) Total payments received from customers, whether cash, notes or acceptances.
(2) Allowances to customers, including cash discount; in other words, the gross settlements with customers.

Balance—
Represents the net amount due from customers.

(1-5)—*Bonds and Other Investments:*

Debits—
(1) Open the account with the market value of stocks and bonds on hand;
(2) Market value of other investments;
(3) Cash value of life insurance policies, etc.;
(4) Cost of all stock, bonds and other investments purchased.

Credits—
(1) Cost of stocks, bonds and other investments sold at value carried (profit or loss debits or credits profit and loss on investments).

Balance—
Represents cost value of stocks, bonds and other investments owned by the company.

2—INVENTORY ASSETS

(2-1)—*Melting Stock—Metals:*

(1) Open the account with the cost value of all melting stock or metals on hand;
(2) All purchases of melting stock metals;
(3) Transportation charges on incoming melting stock metals (distributable according to corresponding invoices);
(4) Unloading charges if a long term supply;
(5) Returns to stores of melting stock from melting department.

Credits—
(1) All withdrawals of melting stock metals as represented by monthly summary of metals used;
(2) All melting stock returned to vendors.

Balance—
Represents the value of melting stock metals on hand and should agree with the aggregate of the individual stock ledger sheets or cards.

Note:—The following subdivisions may be maintained:

1. Pig iron.
2. Purchased scrap.
3. Foundry scrap.
4. Ferromanganese.
5. Ferrosilicon.
6. Other melting stock as required.

(2-2)—*General Stores:*

Debits—
(1) Open the account with the value of all general stores material (i. e., other than melting stock metals) on hand;
(2) Purchases of additional material;
(3) Transportation charges on incoming general stores material (distributable according to corresponding invoices);
(4) Returns to stock general stores material.

Credits—
(1) Withdrawals of general stores material from stock as represented by monthly summary of materials used;
(2) Material returned to vendors.

Balance—
Represents the book value of general stores material on hand and should agree with the aggregate of the individual stock ledger sheets or cards

(2-3)—*Finished Castings:*

Debits
(1) Open the account with the physical value of all finished castings on hand;
(2) Deliveries of finished castings as represented by the summary of closed production orders—at cost;
(3) Returns of good material from customers.

Credits—
(1) Material shipped during the period as represented by summary of reports of shipments;

Balance—
Represents cost value of finished goods on hand.

(2-4)—*Work in Process:*

Debits—
(1) Open the account with cost of goods in process;
(2) With the total amount of molding productive labor and coremaking productive labor as represented by the summary of time cards on pay rolls;
(3) With cost of melt for the month at predetermined rate;
(4) With proper portion of following expense accounts at predetermined rates:
   a. Molding burden—direct labor,
   b. Molding burden—machine hour,
   c. Molding sand cost,
   d. Flask cost,
   e. Coremaking burden—direct labor,
   f. Coremaking burden—machine hour,
   g. Finishing cost,
   h. Annealing cost;
(5) With cost of castings returned by customers (if finished castings account not carried).

Credits—
(1) Cost of castings shipped, if finished castings account not carried, otherwise with cost of finished castings delivered to finished castings stores;
(2) Scrap value of bad castings and sprues returned to melting metals stock;
(3) Losses due to defective work or other errors in service distributable to the departmental expense involved.

Balance—
Represents cost of finished castings on hand and in process (if finished castings account not carried), otherwise of castings in process.

3—FIXED ASSETS

(3-1)—*Machinery and Equipment:*

(3-2)—*Real Estate and Buildings:*

Debits—
(1) Open accounts with the first cost or replacement value of all permanent plant investment represented by the respective accounts;
(2) All expenditures for permanent additions.

Credits—
(1) Value of fixed assets sold, disposed of or otherwise taken out of service.

Balance—
Represents book value of fixed assets against which as offsetting accounts are the respective reserves for depreciation.

4—DEFERRED ASSETS

(4-1)—*Prepaid Insurance:*

Debits—
(1) Open the account with the amount of unexpired insurance premiums;
(2) Subsequent insurance premiums.

Credits—
(1) Periodical charge equivalent to pro rata insurance cost for period;
(2) All refunds and cancellations.

Balance—
Represents unexpired insurance premiums.

(4-2)—*Prepaid Taxes (if prepaid—see 6-4):*

Debits—
(1) Open the account with total of unexpired taxes paid in advance;
(2) Subsequent taxes paid in advance.

Credits—
(1) Amount equivalent to one-twelfth the annual tax to effect liquidation of monthly charge to taxes in the various expense groups.

Balance—
Represents taxes paid in advance.

(4-3)—*Prepaid Interest (See 6-6):*

Debits—
(1) Open with balance of prepaid interest;
(2) All subsequent prepaid interest.

Credits—
(1) With monthly proportions of interest accrued as to the items entered in this account as prepaid.

Balance—
Inventory of unused prepaid interest.

5—INTANGIBLE ASSETS

(5-1)—*Patents:*

Debits—
(1) Open the account with the estimated value of patents owned;
(2) Cost of acquiring subsequent patents including all incidental expenses.

Credits—
(1) Pro rata amount equivalent to one-twelfth the annual charge for the extinguishment of patents. (If so treated.)

Balance—
Represents book value of patents owned.

(5-2)—*Good Will:*

Debits—
With value of good will.

Credits—
With any depreciation of same.

Balance—
Net value of good will as carried.

6—CURRENT LIABILITIES

(6-1)—*Notes Payable:*

Debits—
(1) Payments reducing the notes payable.

Credits—
(1) Open the account with the value of all outstanding notes payable;
(2) All subsequent notes issued.

Balance—
Represents amount owed by the company on notes payable.

(6-2)—*Accounts Payable:*

Debits—
(1) Payments of accounts payable;
(2) With all contra charges to vendors' accounts;
(3) Value of material returned to vendors for credit;
(4) With amount of notes given vendors;
(5) With all trade or cash discounts allowed by vendors and earned.

Credits—
(1) Open the account with the total of vendors' or purchase creditors' accounts;
(2) Total credits to accounts payable on the purchase journal.

Balance—
Represents net amount owed to creditors on open account.

(6-3)—*Accrued Pay Roll:*

Debits—
(1) Amount of wage and salary payments made during the period as represented by cash book entries;
(2) With amounts paid as bonus.

Credits—
(1) Amount of wages, salaries and bonus earned during the period.

Balance—
Represents pay roll amounts accrued but unpaid.

(6-4)—*Accrued Taxes* . (*If accrued—See* 4-2):

Debits—
(1) Actual payment of taxes.

Credits—
(1) Monthly amount charged to operating expense.

Balance—
Represents accrued amount of taxes accumulated but not yet due.

(6-5)—*Accrued Commissions:*

Debits—
(1) Commissions actually paid agents or sales representatives.

Credits—
(1) All accrued commissions on sales billed (or orders taken) during the period, charging selling expenses.

Balance—
Represents commissions accrued but not paid.

(6-6)—*Accrued Interest* (*See* 4-3):

Debits—
(1) With interest paid as to items entered herein as accrued.

Credits—
(1) Open the account with the amount of accrued interest unpaid;
(2) With amounts accrued monthly on items where interest is accruing.

Balance—
Represents accrued interest on items payable accumulated but not yet paid.

7—FIXED LIABILITIES

(7-1)—*Bonds Payable:*

Debits—
(1) Payments reducing same.

Credits—
(1) Open with balance of all outstanding bonds;
(2) With all subsequent issues.

Balance—
Represents outstanding bonded indebtedness.

(7-2)—*Mortgages Payable:*

Debits—
(1) Payments reducing the principal of mortgages payable.

Credits—
(1) Open the account with the total amount due on the principal of all mortgages payable;
(2) Mortgages subsequently issued

Balance—
Represents total amount owing on mortgages payable.

8—RESERVES

(8-1)—*Reserve for Depreciation on Machinery and Equipment:*

(8-2)—*Reserve for Depreciation on Buildings:*

Debits—
(1) With that portion of the cost which has been depreciated of anything replaced or sold.

Credits—
(1) Open the account with the amount of reserve allowed for depreciation;
(2) Depreciation charge to departmental or general expenses equivalent to a pro rata amount of the annual depreciation charge.

Balance—
Represents the allowance for depreciation of permanent plant investments and maintained as offsetting accounts to the respective fixed asset accounts.

Note:—If the present net book value (first cost less depreciation amount) cannot be determined for any particular article replaced, the first cost should be credited to the fixed asset account and charged to the corresponding reserve for depreciation. If, however, the article replaced is sold or otherwise disposed of at a scrap value, the first cost should be credited to the fixed asset account and first cost less scrap or exchange value, should be charged to the corresponding reserve for depreciation. The scrap value should, of course, be charged to the purchaser.

(8-3)—*Reserve for Bad Debts:*

Debits—
(1) With value of accounts receivable, considered uncollectable, crediting the individual customer's account so written off.

Credits—
(1) Open the account with an amount considered sufficient to cover all losses on accounts considered uncollectable;
(2) Amount based on a percentage of sales billed to provide for losses on amounts charged during the period.

Balance—
Represents allowance reserved for losses on accounts receivable.

9—CAPITAL LIABILITIES

(9-1)—*Capital Stock—Preferred Issued:*

(9-2)—*Capital Stock—Common Issued:*

Debits—
(1) With the par value of stock returned to or acquired by the company.

Credits—
(1) With the par value of stock outstanding.

Balance—
Represents the par value of issued capital stock outstanding, preferred and common, respectively.

10—SURPLUS AND PROFIT AND LOSS ACCOUNTS

(10-1)—*Surplus:*

Debits—
(1) With the amount of dividends at annual closing;
(2) With amount transferred from profit and loss (if loss) at annual closing period.

Credits—
(1) Open the account with the amount of undivided profits;
(2) With profits made during the current year transferred from profit and loss at annual closing.

Balance—
Represents undivided profits, if a credit.
Represents deficit, if a debit.

Note:—Make *no* entries to surplus account except at annual closing time.

(10-2)—*Income and Excess Profits Tax Account:*

Debits—
With amount of income and excess profits tax paid.

Credits—
With any necessary adjustments.

Balance—
Represents amount of income and excess profits taxes paid.

(10-3)—*Dividends—Preferred Stock:*

Debits—
(1) With the amount of dividend paid.

Credits—
(1) With debit to surplus at close of year.

Balance—
Represents dividends paid.

(10-4)—*Dividends—Common Stock:*

Debits—
(1) With the amount of dividends paid.

Credits—
(1) With debit to surplus at close of year.

Balance—
Represents dividends paid.

(10-5)—*Profit and Loss:*

At Annual Closing Time:

Debits—
(1) With debit balance of cost of castings sales;
(2) With debit balance of cost of miscellaneous sales;
(3) With debit balance of freight out on sales;
(4) With debit balance of administrative expenses;
(5) With debit balance of selling expenses;
(6) With debit balance of interest paid;
(7) With debit balance of discount given;
(8) With net amount of plant balances (operating expense accounts Nos. 12-1 to 12-18 inclusive) if such amounts are debit balances;
(9) With debit balance of adjustment.

At Annual Closing Time:

Credits—
(1) With credit balances of castings sales billed;
(2) With credit balance of miscellaneous sales;
(3) With credit balance of interest received;
(4) With credit balance of discount taken;
(5) With credit balance of interest on investments;
(6) With net amount of plant balances (operative expense accounts 12-1 to 12-18 inclusive) if such amounts are credit balances;
(7) With credit balances of adjustment account.

Balance—
Represents net profit or loss resulting from transactions of the period accumulated and should be transferred at end of the fiscal year to surplus.

(10-6)—*Adjustment Account:*

Debits—
(1) With any determinable decrease in any particular account not traceable to some other account;
(2) With necessary adjustments of any nature.

Credits—
(1) At closing periods with any determinable increase in any particular account not traceable to some other account;
(2) With necessary adjustments of any nature.

Balance—
Represents adjustments necessarily made.

(10-7)—*Castings Sales:*

Debits—
(1) With the billed amount of castings returned by customers;
(2) With allowances to customers as represented by credit memoranda if a sale reduction;
(3) With credit balance, transferring to profit and loss at annual closing time.

Credits—
(1) Total casting sales billed during the month as represented by the sales register, charging accounts receivable.

Balance—
Represents net sales billed.

(10-8)—*Cost of Casting Sales:*

Debits—
(1) Cost value of all material shipped as represented by summary of daily reports of shipments.

Credits—
(1) Cost of material returned by customers during the period;
(2) With the debit balance at the end of closing periods charging profit and loss.

Balance—
Represents net factory cost of shipments.

(10-9)—*Miscellaneous Sales:*

Debits—
(1) With value at sale price of any returned sales.

Credits—
(1) With sale value of any nature other than castings sales.

Balance—
Value of miscellaneous sales.

(10-10)—*Cost of Miscellaneous Sales:*

Debits—
(1) With cost of above sales.

Credits—
(1) With cost of any returned sales.

Balance—
Net cost of miscellaneous sales.

(10-11)—*Freight Out On Sales:*

Debits—
(1) With all payments of transportation of any nature for delivery of goods to customers.

Credits—
(1) With necessary adjustments.

Balance—
Net cost of delivering sales to customers.

(10-12)—*Administrative Expenses:*

Debits—
(1) With the aggregate of charges to all expense accounts classified as administrative expenses.

Credits—
(1) With debit balance at closing periods charging profit and loss.

Balance—
Represented aggregate of administrative expenses.

(10-13)—*Selling Expenses:*

Debit—
(1) With the aggregate of charges to all expense accounts classified as selling expenses.

Credits—
(1) With debit balance at closing periods charging profit and loss.

Balance—
Represented aggregate of selling expenses.

11—FINANCIAL PROFIT AND LOSS ACCOUNTS

(11-1)—*Interest Received:*

Debits—
(1) With necessary adjustments.

Credits—
(1) With all interest received for balances or overdue accounts.

Balance—
Net interest received.

(11-2)—*Discount Taken:*

Debits—
(1) With credit balance, transferring to profit and loss.

Credits—
(1) With all cash discounts earned; does not include trade discounts.

Balance—
Represents cash discounts earned.

(11-3)—*Interest Paid:*

Debits—
(1) At closing periods with the amount of interest accrued for the month on items payable, crediting accrued interest or prepaid interest.

Credits—
(1) With debit balance, transferring to profit and loss.

Balance—
Represents amount of interest actually incurred.

Note:—If interest is prepaid, the payment should be charged to prepaid interest (Acct. 4-3). The amount should be liquidated in monthly amounts to apportion the charge equitably over the periods involved. Likewise, watch for action of accruing interest as explained in Account 6-6.

(11-4)—*Discount Given:*

Debits—
(1) Cash discounts allowed customers—does not include trade discounts.

Credits—
(1) With debit balance, transferring to profit and loss.

Balance—
Represents cash discounts allowed

(11-5)—*Interest or Dividends on Investments:*

Debits—
(1) With necessary adjustments.

Credits—
(1) With interest or dividends received on investments. This should be treated as separate from regular commercial interest.

Balance—
Net results of regular income outside investments.

12—OPERATING EXPENSES

Explanatory Note:

Accounts 12-1 to 12-18 inclusive cover the actual operating accounts; i. e., those that appear in the actual cost sheet, either by pound or percentage.

If reference is made to the skeleton statements, it will be noted that "Total to Date" is used, both in the body of the statement and in the comparative monthly statement.

It is quite evident, therefore, that if we should have but one account for each burden and cost statement, and credit this with the transfer at pre-

determined rates to work in process we would have no easy way of securing our "To date" figures.

In order to make this easy, we have two ledger accounts for each expense or burden account.

One bearing simply the name of the account, is for *debits only,* except where a credit is necessary to *adjust or correct the debits.*

The other, bearing the account name, followed by "Credits," is for *credits only* of the transfers to work in process, except when a debit may be necessary to *adjust or correct the credits.*

The result of this is that we have an accumulating figure for each kind of account which gives us from the general ledger trial balance the figures to use in our statements of "Total to Date" the monthly figures coming from our footings for the month's transactions, which *must* balance with the entries for the month in the ledger account controlling each expense account.

It is quickly seen, therefore, that the difference between the "debit" and "credit" account for each expense account is the over or under absorbed expense, and will and *must* agree with the monthly statements.

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Accounts 12-19 to 12-22 inclusive need but a single account as they are to be *entirely closed out* each month, being simply collective accounts as a medium to split down these expenses to the actual operating accounts.

* * * * * * *

(12-1)—*Cost of Melt:*

Debits—
(1) Melting stock metals used (requisitions).
(1) Melting stock metals used (requisitions);
(2) Labor (time cards);
(3) Miscellaneous materials (requisitions);
(4) Charges direct from purchase register (expense ledger charge slips);
(5) Apportioned charges.

Credits—
(1) Adjustments of debits only.

(12-2)—*Cost of Melt—Credits:*

Debits—
(1) Adjustments of credits only.

Credits—
(1) Value of metal poured at the standard predetermined rate.

(12-3)—*Molding Burden—Direct Labor:*

Debits—
(1) Labor (time cards);
(2) Materials (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) Apportioned charges.

Credits—
(1) Adjustments of debits only.

(12-4)—*Molding Burden—Direct Labor—Credits:*

Debits—
(1) Adjustment of credits only.

Credits—
(1) Amount equal to molding direct labor x standard rate.

(12-5)—*Molding Burden—Machine Hour:*

Debits—
(1) Labor (time cards);
(2) Materials (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) Apportioned charges of power and depreciation.

Credits—
(1) Adjustment of debits only.

(12-6)—*Molding Burden—Machine Hour—Credits:*

Debits—
(1) Adjustments of credits only.

Credits—
(1) Amount equal to actual machine hours used x standard rate per hour.

(12-7)—*Molding Sand Cost (If used):*

Debits—
(1) Labor (time tickets);
(2) Materials (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips).

Credits—
(1) Adjustments of debits only.

(12-8)—*Molding Sand Cost—Credits (If used):*

Debits—
(1) Adjustments of credits only.

Credits—
(1) Amount equal to total metal poured x standard rate per pound.

(12-9)—*Flask Cost (If Used):*

Debits—
(1) Labor (time tickets);
(2) Materials (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) With total monthly charges in pattern shop expense accounts Nos. 704 and 705 (by transfer).

Credits—
(1) Adjustments of debits only

(12-10)—*Flask Cost—Credits (If used):*

Debits—
(1) Adjustments of credits only.

Credits—
(1) Amount equal to total good castings x standard rate per pound.

(12-11)—*Coremaking Burden—Direct Labor:*

Debits—
(1) Labor (time tickets);
(2) Material (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) Apportioned charges.

Credits—
(1) Adjustments of debits only.

(12-12)—*Coremaking Burden—Direct Labor—Credits:*

Debits—
(1) Adjustments of credits only.

Credits—
(1) Amount equal to coremaking direct labor x standard rate.

(12-13)—*Coremaking Burden—Machine Hour:*

Debits—
(1) Labor (time tickets);
(2) Material (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) Apportioned charges.

Credits—
(1) Adjustments of debits only.

(12-14)—*Coremaking Burden—Machine Hour—Credits:*

Debits—
(1) Adjustments of credits only.

Credits—
(1) Amount equal to actual machine hours used x standard rate per hour.

(12-15)—*Finishing Cost:*

Debits—
(1) Labor (direct and indirect unless in large plants) (time tickets);
(2) Material (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) Apportioned charges.

Credits—
(1) Adjustments of debits only.

(12-16)—*Finishing Costs—Credits:*

Debits—
(1) Adjustments of credits only.

Credits—
(1) Amount equal to molding and core direct labor x standard rate.

(12-17)—*Annealing Cost:*

Debits—
(1) Labor (time tickets);
(2) Material (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) Apportioned charges.

Credits—
(1) Adjustments of debits only.

(12-18)—*Annealing Cost—Credits:*

Debits—
(1) Adjustments of credits only.

Credits—
(1) Amount equal to total good castings x standard rate.

(12-19)—*Power, Light and Heat:*

Debits—
(1) Labor (time cards);
(2) Material (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) Apportioned charges.

Credits—
(1) With total net balance at the close of each month distributed on a percentage or other basis to the various operating accounts as explained elsewhere.

Balance—
There should be no balance.

(12-20)—*Pattern Shop Expense:*

Debits—
(1) Labor (time tickets);
(2) Materials (requisitions);
(3) Charges direct from purchase journal (expense ledger charge slips);
(4) Apportioned charges.

Credits—
(1) With amount in order 702 charging molding burden—direct labor;
(2) With amount in order 703 charging coremaking burden—direct labor;
(3) With amounts in orders 704 and 705, charging flask cost.

(4) With amount of residue as directed.

Balance—

There should be no balance.

Note:—If pattern shop is operated as a producing department, and not solely as a co-operating department, the accounting shall be changed to correspond to the condition and provision made for:

1—Pattern production orders;
2—Pattern productive labor;
3—Pattern shop expense account;
4—Pattern work in process material and cost compilation changed accordingly.

(12-21)—*General Expense:*

Debits—

(1) Labor (time tickets);
(2) Material (requisitions);
(3) Charges direct from purchase journal (expense ledger debit slips);
(4) Apportioned charges.

Credits—

(1) With total net balance at end of each month distributed on the prescribed basis to each operating account.

Balance—

There should be no balance.

(12-22)—*Expense Ledger Account:*

Debits—

(1) At end of each month with total of charges made direct to operating accounts, which charges are represented by expense ledger charge slips.

Credits—

(1) With the total of expense ledger charge slips charging the various operating accounts.

Balance—

If any balance exists, it is in error, and the charge slips in the files for month should be checked back to the purchase journal.

13—SUNDRY GENERAL LEDGER ACCOUNTS

In this section of the ledger will be located all sundry accounts with firms and individuals, irrespective of whether their balance is debit or credit.

There are always a certain number of accounts that float around without any particular home, and this is the place to put all such.

When making up a statement, the accounts classify themselves according to their balance into two classes, i. e.:

General ledger accounts receivable;
General ledger accounts payable.

They will be so entered in the statements immediately under the accounts receivable, and accounts payable respectively.

Comments Regarding Starting Cost Work

While these comments are in numbered sequence, practically all may and should be handled at once.

First:—Get your house in order.

(a) Clean up your shop.

(b) See that a day's work goes through your entire shop in a day—that is—that each department is so tuned up with the others that there is a steady flow of work. Above all things, see that all work goes through and out of shop in sequence of the originating pouring of castings, *except* that you provide storage or accumulation points for the sorting and classifying of like castings in order to put them through finishing operations in lots.

(c) The foregoing is absolutely necessary; system or no system of costs, as it is only good business. But no system of costs or production follow up is worth a snap of a finger unless the plant is onto its job as to orderliness, and common everyday clean cut handling of its details.

Second:—Get your raw materials and supplies under proper storage control. If you have no stock room—build one. Why should you pay your good money for material—and then let anyone at all dip in to their hearts' content?

Third:—Get a clock for all employes to ring *in* and *out* on, so that you have some sound basis for timekeeping.

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When you get squared away, with materials in stock rooms, and your pig iron, etc., in order, then start records.

Fourth:—It is most important to have a proper production order. Never mind what it is if you provide for telling your shop what and how many to make. While doing this, provide a method to record *what is made,* so that you know in each department just how your work is progressing. See how easy it is when your shop *keeps* it *going.*

Fifth:—Start time cards. Best to be 3" x 5" for easy filing. One job of one man for one day only to a time card. If possible, have your time recorded by timekeeper. Bad business depending on a laborer to be a record keeper; besides it's *cheaper* to *specialize* clerical work vs. mechanical.

Sixth:—Put into use the code of expense order shown herewith. You will delight in knowing where your money is going.

Seventh:—Let no material be used without a record. Requisitions 4" x 6" are best, as they fit a standard file—get an old crank for a storekeeper and he will pay his salary many times over in reduced material costs.

Eighth:—Provide a *real man* to handle your costs. One who understands the plant operations, and who understands the office end. *It will pay*—and pay well. Cost work is not a boy's job, and if made so had better be left alone.

* * * * * *

Remember this. The finding of costs accomplishes two things:

First:—Tells you what you must charge for your goods to make a profit.

Second:—And perhaps the greater point of the two, it tells you just where your money goes—and if you go at it in a red-blooded way, you can make large cuts in your costs.

Forms? The least part of the game, except to have them the best for economical handling. The forms are the vehicles only of what you collect. The biggest thing is to *get behind it*—everyone pulling the same way, realizing that costs *must be known.*

Book Review

Graphic Production Control, by C. E. Knoeppel; cloth, 477 pages, 6 x 9; published by the Engineering Magazine Co., New York, and for sale by THE FOUNDRY. Price, $10 postpaid.

The basic principle that picturization conveys more to the average intelligence than do words or figures has formed the premise upon which Mr. Knoeppel has built a practical treatise of great value to the modern industrial world. Visualizing ideas is the theme, and the author has followed his own precepts faithfully in presenting his subject matter, both through the exceptional clearness of his writing and the free use of detailed suggestion to illustrate the points offered.

Mr. Knoeppel states that forms, figures and statistics depend for their intelligent use upon the preceptive faculty of the user. Therefore, he enhances preception and aids intelligence by picturing for his reader the essential data required in attacking industrial problems. The use of graphic charts almost to the entire exclusion of other methods of presenting figures, statistics, summaries and other essential information required in handling the armies during the war is touched upon as an example of simple, efficient management. The application of this war taught lesson to meet the imperative demands for more production during the reconstruction period is shown. The author then states the fundamental laws which underlie efficient management. He draws a minute outline of the analysis upon which graphite production is based. He impresses the need for efficient organization, as preliminary to graphic control and gives minutely and step by step the method for establishing the mechanism of his system.

Mr. Knoeppel's method has been in use in a number of large foundry, metal-working and machine shops, and also has been applied in the following manufacturing lines: Textile machinery, gas traction engines, steel plate construction, metal furniture, automobile axles and transmissions, small motors, taps, dies, hardware, clothing, rubber tires, oil producing and refining, and in automobile assembling plants.

Manufacturing Chilled Iron Car Wheels - VI

Procedure for Small Wheels Varies from Methods Already Described

BY H. E. DILLER

Thus far this series of articles has dealt almost exclusively with the manufacture of chilled iron wheels for railroad use. There are a great many purposes for which smaller wheels are used, and these require a somewhat different process of manufacture. There is more variation in size and design of the small wheels than of the standard car wheels, due to the great variety of uses to which the small wheel is put, as a number of instances will show. Few of the smaller wheels have double plates, a single plate being used for almost all of the small wheels which are not spoked. This plate frequently is reinforced with ribs of different design and many patterns are required for this type. Spoked wheels frequently have the spokes curved so that they may straighten and not break from the rim as the metal in the wheel sets and contracts, although some of the smaller wheels are made with straight spokes. One notable difference in the design of some small wheels from that of the standard wheel is in the hub which is made hollow to provide for oiling the axle bearing. In such wheels oil is put into the hollow hub from whence it is fed to the journal bearing, instead of being carried by cotton waste in the journal box as is the custom on railroad freight cars.

Probably the nearest approach to the standard wheel in size and weight is that used for street cars. This may be spoked or made with a solid body according to the desire of the designing engineer. The American Electric Railway association has no specification for chilled iron wheels and each manufacturer of street cars purchases according to his individual specifications. However, the chilled iron wheel does not have the prestige among builders of street cars that it possesses in the freight car industry and a smaller percentage of street cars are equipped with this type.

The smallest wheels made in large numbers with a chilled iron tread are those made for mine cars. These are produced under a great variety of conditions, two extremes being represented by the company which makes wheels for its own use and pays little attention to any requirements except that the wheels be free from cracks. The other is the foundry which makes wheels for the trade and is highly considerate of the reputation of its product.

An instance of the first class is a large steel company which required wheels for its own mine cars. The effort was made to produce these wheels, which were the spoked type, without annealing. A great many of the wheels broke when made from an iron which took a chill. Therefore, it was decided to try a softer metal. A mixture consisting mainly of broken ingot molds was tried and the resulting wheels were found to be free from cracked spokes. When the wheels were broken to examine their fracture it was found that the metal in the tread was close grained and dense, but was not white. These wheels are used without any anneal an gave service which is satisfactory to the steel company. No record has been kept of the length of life of the wheels but the number of renewals indicates a reasonable long service. Only one large purchaser of mine car wheels buys to

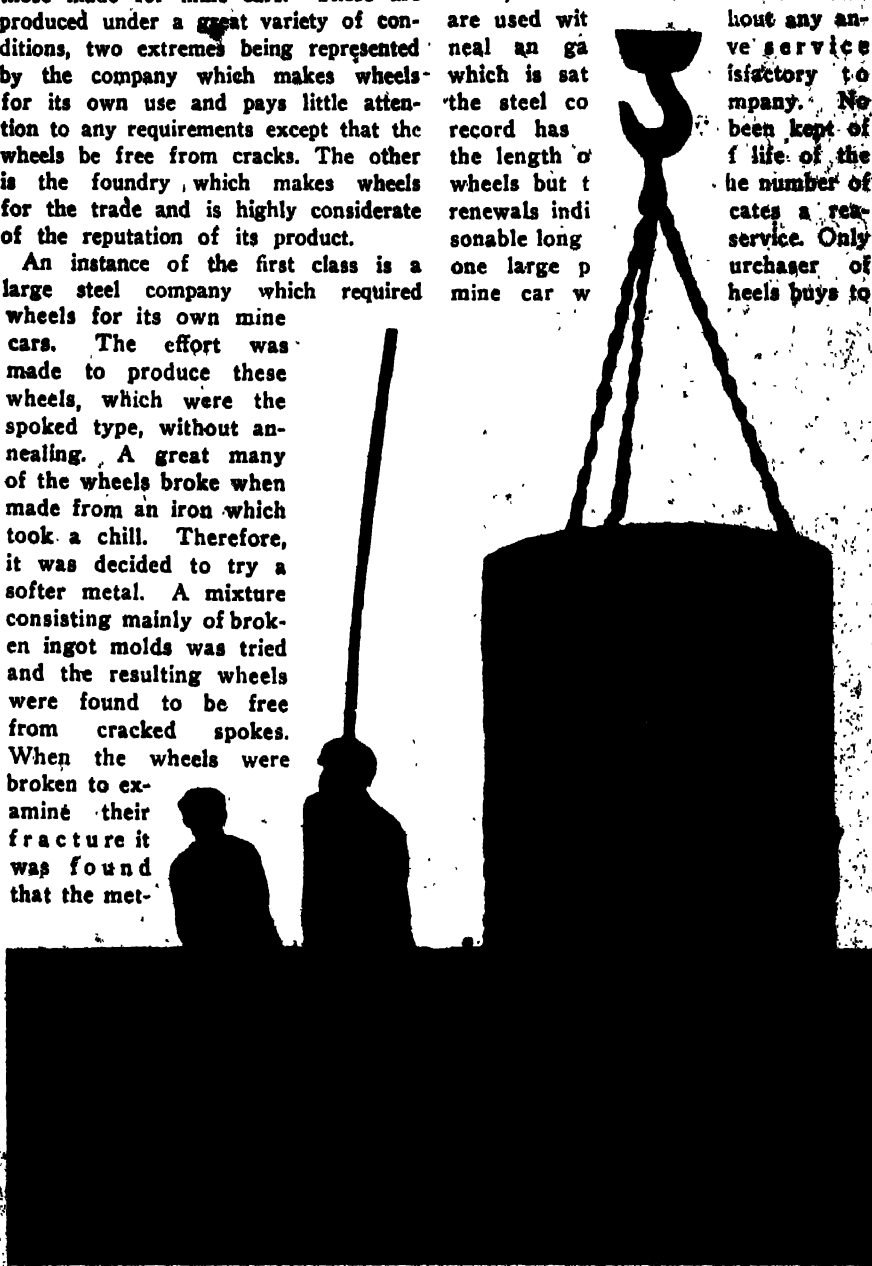


FIG. 54—SMALL WHEELS ARE LOWERED INTO STEEL TANKS IMBEDDED IN THE FLOOR OF THE FOUNDRY IMMEDIATELY AFTER BEING CAST. WHEN THE ANNEAL IS FINISHED THE TANKS ARE LIFTED FROM THE PITS BY A CRANE—EACH TANK HOLDS ONE DAY'S CAST

specification. For this reason the manufacturer is bound only by his judgment as to the method of producing a wheel which will sustain his reputation at the lowest manufacturing cost.

That many of these manufacturers value the reputation of their product highly is illustrated by the number of them who go to the expense of adding as high as 25 per cent high-priced charcoal pig iron to the mixture. The reason for the use of charcoal iron as well as the subject of scrap iron in mine car wheels has been discussed when considering the metallurgy of railway, car-wheel iron.

The composition of mine car wheels is fairly well standardized, although the wheels are made by various small foundries which do not have an organization as do the manufacturers of the standard chilled iron car wheels. This may be due to the fact that one large user of mine car wheels issues a specification which many foundrymen believe to be the best practiced. However, no results of tests of wheels made to this specification have been published.

As might be expected, the silicon content of the small mine wheel is raised, and the iron mixture usually contains from 0.75 to 0.85 per cent silicon compared with 0.45 to 0.70 per cent in the standard wheels. Phosphorus is kept about the same in both classes of wheels, and ranges from 0.20 to 0.40 per cent. The upper limit seldom is reached in mine car wheels and some manufacturers keep the phosphorus below 0.30 as called for in the specifications where mentioned. The reverse is true in regard to manganese which, while keeping within the same limits in both classes of wheels, is kept nearer the upper figure in the mine car wheels and usually will come within the limits of 0.60 to 0.80 per cent.

Trouble Due to Sulphur

Practically all mine, car-wheel foundrymen agree that sulphur is detrimental to the iron and that the chill should be secured from using charcoal iron instead of from high sulphur content although the chill could be regulated by the silicon content. This is characterized by the expressions *sulphur chill* and *charcoal chill* used among mine car wheel manufacturers. The specifications which have been issued call for sulphur below 0.095 per cent and this may account for the general aversion to high sulphur iron held by the manufacturers of mine car wheels. Of course, if a foundry is accustomed to handling low sulphur iron trouble probably would be encountered if the amount of sulphur was raised before the foundryman became familiar with handling this grade. The objection that high sulphur in the iron makes the wheels red short and is apt to cause trouble when the wheel becomes overheated in braking would not hold as strongly for wheels running in the damp mines and braked with wood brakes as when the wheel is carrying cars which are gripped by a hard metallic brake for several miles at a time, as is the case with freight car wheels.

Foundries which make the standard wheels also sometimes cast smaller wheels. In such cases the order for small wheels usually is divided between several molders. This is done because it is considered that more skill is required to make the small wheel on account of variations from the regular standard practice with which the molders are familiar. It also requires greater effort from the molder and work on the standard wheel is preferred almost universally. Fig. 57 shows a mold for a small wheel in a shop which makes standard wheels. Only part of the line is clear for small molds, and the molder is allowed to put up part of his day's work in standard molds. The wheel for which the mold has been made,

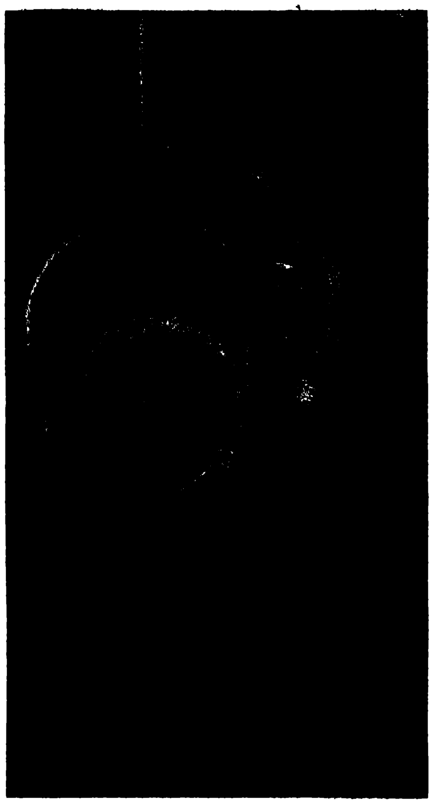


FIG. 57—THE MOLDER IN A SHOP TURNING OUT STANDARD CAR WHEELS DOES NOT LIKE TO MOLD SMALL WHEELS

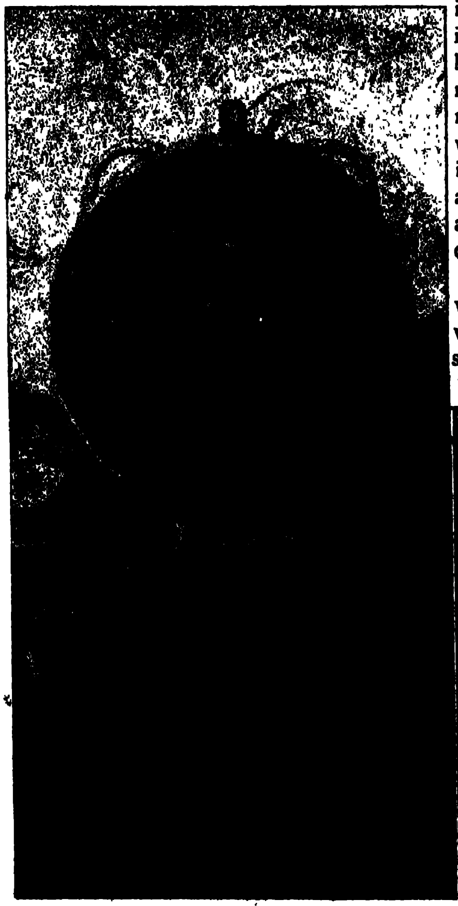


FIG. 55—THE MOLD FOR THE MINE CAR WHEEL OFTEN IS COMPLICATED BY A HUB

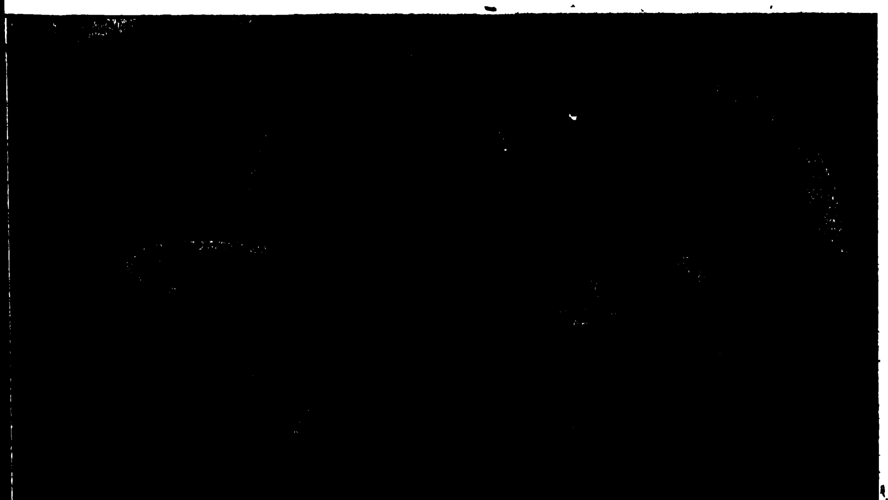


FIG. 56—FLASKS, PATTERNS, CORE AND CHILLER GIVE AN IDEA OF THE WORK REQUIRED TO MAKE A MINE-CAR WHEEL—NOTE THE HINGE ON THE FLASK

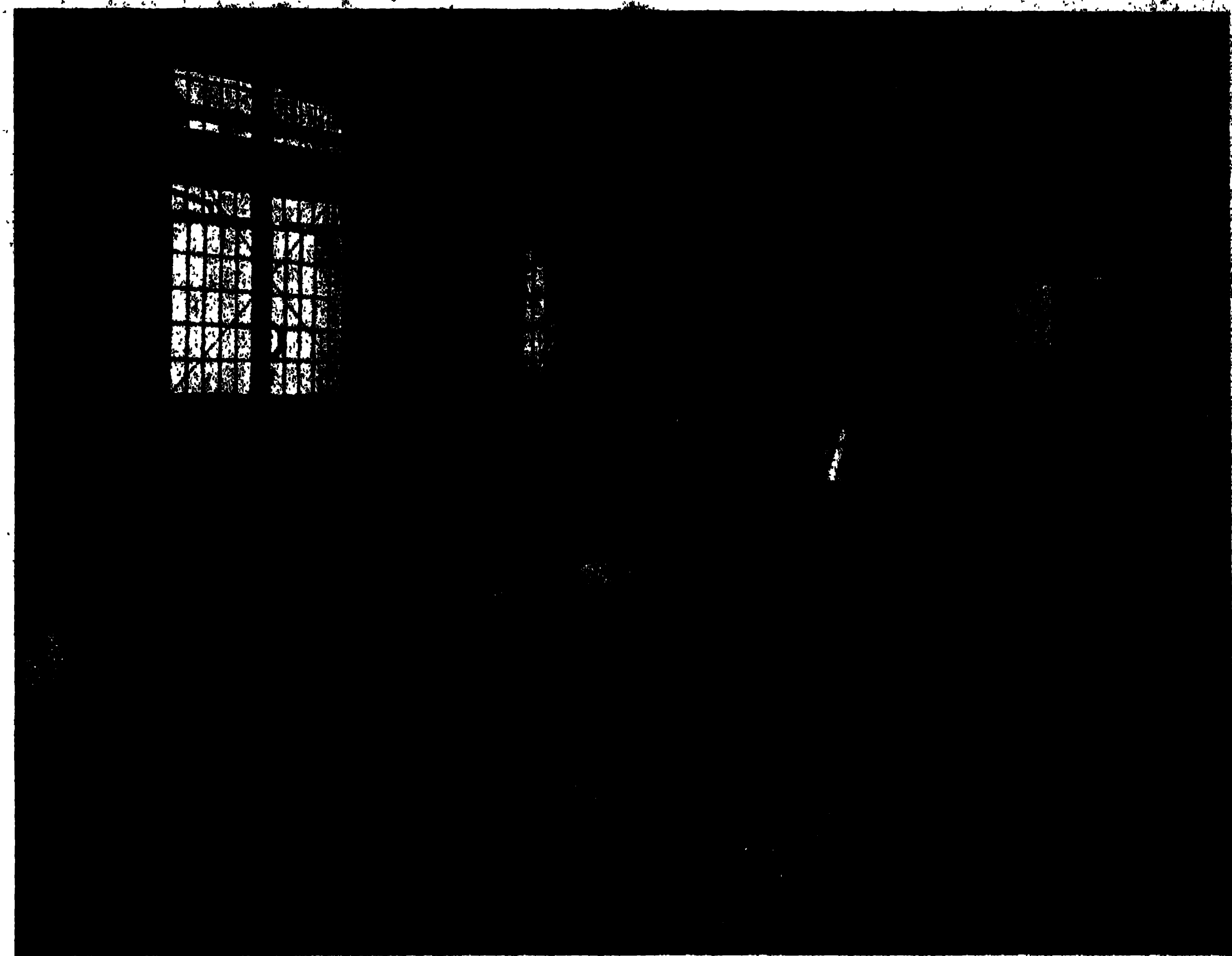


FIG. 58—FEW SMALL-WHEEL SHOPS HAVE A SYSTEM AS SHOWN HERE IN WHICH THE METAL IS CARRIED FROM THE CUPOLA TO THE POURING LADLE BY A CRANE—THE POURING LADLE TRAVELS ON AN OVERHEAD RUNWAY

has spokes and a solid hub. Therefore, no ring core is required, but center and gate cores are sufficient. One of the gate cores may be noted in the center of the cope, and another lies beside the drag. Metal is poured through half of the holes shown. The other holes do not extend entirely through the core, but form lugs on the hub of the casting.

Few of the smaller foundries making mine car wheels have mechanical means for handling molds or carrying metal. It is possible to get along in this way because of the smaller size of the molds, which can be handled by the molders. One of the foundries manufacturing car wheels is equipped with a monorail system for carrying the metal to the molds. A row of molds is set on either side of each monorail. The molds are poured from 1000-pound ladles which receive the metal from a mixing ladle into which it is tapped. The mixing ladle is carried to the molding floor by a traveling crane. Fig. 58 shows metal being transferred from the mixing ladle to the pouring ladle.

The mold shown in Fig. 55 illustrates the design of flask used. Instead of having two dowel pins to locate the cope on the drag, a hinge and one dowel pin are used. The construction of the hinge may be noted in Fig. 56, which shows the equipment for making the mold. The hub core may be seen at *A*. This core is required by the design of the wheel which has a patented oiling system.

Annealing is carried on somewhat differently in the small wheel foundry. Care must be taken to get small wheels into the annealing pits as soon after they are cast as possible. The wheels are not piled evenly on each other but are thrown irregularly into large containers. The annealing equipment of one foundry is shown in Fig. 54. At the right is one of the tanks which are placed in pits in the ground and covered with steel tops. These covers have holes to which other smaller doors are fitted. When wheels are to be charged the smaller covers are removed and solid wheels, such as the one shown to the extreme left of the illustration, are dropped through the hole uninjured by the impact. Spoked wheels are let down on a hook until they rest on the pile of wheels in the tank. The wheels are allowed to cool in the tank under ground for three or four days. The tanks then are lifted by a crane and carried to the cleaning room. Here they are set on the floor, the clamps, one of which is shown at *A*, Fig. 46, are loosened. When a tank again is raised by the crane the wheels fall on the floor. The tank is carried back and after another bottom plate has been attached it is put back into the pit and is ready to receive more wheels. After the dumped wheels are somewhat cooled they are cleaned by tumbling.

The United States civil service commission announces an open competitive examination for ordnance research engineer. A vacancy at the Frankford arsenal, Philadelphia, and vacancies in positions requiring similar qualifications, in the ordnance department at large or other branches of the service, at $4000 to $5000 a year, or higher or lower salaries, will be filled. Applications must be filed prior to June 22, 1920.

Cast Iron Made From Steel Turnings

The Process of Removing the Carbon From Cast Iron to Produce Steel is Reversed —Steel Turnings and Other Machine Shop Scrap Are Recarbonized to Produce Cast Iron

SYNTHETIC cast iron is the term by which, since the commencement of its manufacture in the electric furnace, the inventor of the process has always described the iron obtained by the recarburizing melting of steel turnings. This term has since passed into metallurgical currency, and has now become generic. The novelty of its manufacture consists in carburizing iron and steel scrap; more particularly turnings, by melting these materials in the presence of carbon, which is introduced simultaneously with them in the melting appliance. The electric furnace is plainly indicated as best fulfilling all the conditions required for the carrying out of this operation. Only a process of continuous carburization, effected during the course of melting a mixture of steel turnings and carbon could conduce to an economic method of producing synthetic cast iron with a commercial future capable of development. In an electric furnace charged with steel turnings mixed with carbon the carburization is not only absolutely controlled by the known reactions of the substances present, but it should be noted as an important economic advantage that the combination of the carbon with the iron begins in the upper parts of the charge long before actual fusion. Cementation intervenes from a temperature of 650 degrees upward and becomes more rapid in proportion as the temperature rises, owing to the descent of the charge.

Carburization of the iron takes place subsequently, by the contact between the solid carbon and the partially carburized metal in the course of melting, and becomes complete on full melting, the temperature of which is determined by the nature of the iron, so that casts can easily be obtained in the electric furnace at temperatures of 1200 degrees to 1300 degrees Cent.

The mixture of steel turnings and carbon possessing, in itself, very high conductivity, it would become necessary, to ensure normal working in the electric furnace, to use so low a potential that higher currents than those ordinarily in use could be employed. On the other hand, it would be a pity to employ electric fusion without profiting by the metallurgical advantages involved, in order to effect desulphurization. The introduction of basic slag into the charge meets these two requirements.

The iron obtained in the presence of a sufficiently basic slag, which combines with the small amount of silica introduced, will contain practically all the substances contained in the charge, except the sulphur. There will be no increase in the silicon, and the carbon in the charge will be used up solely in carburization, without any appreciable intervention of the silica. White cast iron can thus easily be obtained with ordinary steel turnings. With turnings containing 0.44 per cent of silicon, 0.55 per cent of manganese, and 0.07 per cent of sulphur a white iron of the following composition was obtained: Carbon, 3.55 per cent; silicon, 0.52 per cent; manganese, 0.48 per cent; sulphur, traces. Hence control of the percentages of silicon and of other elements becomes easy; for example, extra silicon will result from introducing more silica into the charge, along with a corresponding amount of carbon for reducing it. The percentage of silica in the slag will vary according to the percentage of silicon in the iron.

It will have been thoroughly understood from what has been said that control of the composition of the slag must be strictly exercised; also that the amount of carbon introduced must be accurately known. The process being one of great accuracy, is correspondingly highly sensitive. It is necessary therefore, to rely entirely on the help of the chemical laboratory.

The carbon employed for carburizing should correspond, so far as its physical condition is concerned with the size of the steel turnings, so that the contact between the particles may be as perfect as possible. Small coke is highly suitable, and so is wood charcoal. The system that has been described is one of extreme simplicity. It does not require any skilled workmen as the results sought are independent of any technical manipulation except in so far as the preparation of the charge is concerned, and depend entirely on an accurate knowledge of the composition of all the components. The electric furnace, fed continuously by the charge, works regularly and with very small losses, as the heat transmitted by the electric hearth situated immediately beneath the charge is, to a very large extent, utilized in heating up the materials and effects a preliminary carburization prior to melting. This enables the consumption of electrical energy to be reduced to as little as 675 kilowatt hours per ton of pig in a 2500-kilowatt furnace of 80 to 100 tons. Maintenance of a furnace, working in the manner described, is barely appreciable, seeing that with a six months campaign at Livet the above furnace did not require any repairs either to linings, shell or any other part.

The fundamental economic considerations in the manufacture of synthetic pig are as follows: (1) The electrode consumption can be lowered to as little as 13.6 pounds per ton, with electrodes of good quality. (2) The consumption of unoxidized turnings is 2310 pounds per ton (2240 pounds) of iron, a figure which, even with moderately rusty scrap, becomes only a little over 2400 pounds. (3) The amount of coke with 80 per cent fixed carbon required to produce a ton of strong pig iron with 3 per cent of carbon and 1.75 per cent of silicon, starting with normal turnings of shell

THE process of making synthetic cast iron; or the recarburization of steel scrap furnishes another evidence of metallurgical achievement made possible by the adoption of the electric furnace as a melting medium. Like many other processes and discoveries synthetic cast iron was brought into existence and developed during the war period because it was designed primarily for the production of semisteel shells.

The general economy of the process, combined with the simplicity of the method of carrying it out, makes it highly probable that while synthetic cast iron found a wide field of application during the war, owing to the large production of steel turnings derived from shell manufacture; it will find no less a field after the war in producing material with steel-like qualities required for mechanical parts.

Abstract from paper read before the Iron and Steel Institute. The author, Charles Albert Keller, Livet, France, is the inventor of the process.

USES OF IRON AND STEEL ETCHING SOLUTIONS

By Roy S. Kerns

Table Giving the Uses of Various Etching Solutions and the Structures Revealed by Each

CONSTITUENT	REAGENT	TIME	WASH	STRUCTURE	METHOD	REMARKS
General structure of iron and steel	Nitric acid and alcohol [illegible]	10 sec.	Alcohol	Grain boundries	Immersion	
General structure of iron and steel	Picric acid and alcohol	[illegible] sec.	Alcohol	Grain boundries	Immersion	Ferrite not [illegible] etched
General structure of iron and steel	Concentrated nitric acid	1 min.	Abundant water	Grain boundries	Immersion	Ferrite [illegible] etched
Cementite	Sodium picrate	5 to 10 min.	Alcohol	Cementite brown Ferrite unaffected	Immersion	Solution [illegible] boiling
Phosphorus	Stead's reagent	60 sec.	Boiling water and methylated alcohol	Segregated spots and stripe	Covered with a layer of reagent	Copper is deposited on the [illegible]
Phosphorus	Heat-tinting	Depending on color		Segregated spots and stripe	Placed on surface	Yellow-brown [illegible]
Ferrous sulphide	Heat-tinting	Heat until brownish tint		Segregated spots and stripe	Placed on surface	Purple
Manganese sulphide	Heat-tinting	Heat until brownish tint		Segregated spots and stripe	Placed on surface	White
Sulphur	Printing with silk			Spots	Pressed on silk	Spots appear on silk
Sulphur	Printing with silver bromide paper			Stains, dark	Pressed on paper, moisten with dilute sulphuric acid	Appear dark, [illegible]
Sulphur	Gelatin with acid solution of lead, mercury or cadmium			Stains yellow, of lead, mercury, or cadmium sulphides	Cover surface.	
Wrought Iron	10% sol. of nitric acid and alcohol	10 to 15 sec.	Alcohol	Grains with slag inclusion dark	Immersion	
Wrought Iron	5% sol. of picric acid and alcohol	30 sec.	Alcohol	Grains with slag inclusion dark	Immersion	
Pearlite	Nital	8 to 10 sec.	Alcohol	Laminated strips of iron carbide and iron	Immersion	Iron white iron carbide dark
Pearlite	Picric acid	20 sec.	Alcohol	Laminated strips of iron carbide and iron	Immersion	Ferrite or Cementite bright, pearlite dark

(Concluded on Data Sheet No. 338)

USES OF IRON AND STEEL ETCHING SOLUTIONS

By Roy S. Kerns

Table Giving the Uses of Various Etching Solutions and the Structures Revealed by Each

(Concluded from Data Sheet No. 337)

CONSTITUENT	REAGENT	TIME	WASH	STRUCTURE	METHOD	REMARKS
Sorbite	Nital	7 to 8 sec.	Alcohol	Granular	Immersion	Ill defined
Sorbite	Picric	15 sec.	Alcohol	Granular	Immersion	Ill defined
Troostite	Nital	2 to 3 sec.	Alcohol	Irregular and granular	Immersion	Darker than Martensite or Sorbite accompanying it
Troostite	Picric	5 sec.	Alcohol	Irregular and granular	Immersion	Darker than Martensite or Sorbite accompanying it
Martensite	Nital	5 sec.	Alcohol	Intersecting needles parallel to sides of triangle; zigzag lances and shafts with austenite	Immersion	Light color
Martensite	Picric acid	10 sec.	Alcohol			
Austenite	Nital	3 to 5 sec.	Alcohol	Polyhedra often worse much twinning in presence of Martensite		Bright
Austenite	Picric	5 to 6 sec.	Alcohol	Polyhedra often worse much twinning in presence of Martensite		Bright
Manganese	Nital	5 sec.	Water	Grains		Bright
High Speed Steel	Yatsevitch Reagent	10 to 12 sec.	Alcohol and water	Web structure of free cementite		Dark
Cast Iron	Common reagents	10 sec.	Alcohol	Grains and graphite strips in gray cast iron spots of carbon in malleable cast iron	Immersion	
[illegible]	[illegible] solution of [illegible]	2 min. [illegible] 30 min.	Alcohol	Grains	Immersion	
[illegible]	[illegible]	2 sec.	Water	Grains	Immersion	
[illegible]	[illegible]	[illegible]	Water	Grains	Immersion	

steel, is about 176 pounds. (4) A furnace of the 80 to 100-ton type should be provided with mechanical appliances for upkeep and charging, so that its operation does not require more than 15 workmen for the preparation, by hand, of the charge, for charging, and for regulating the furnace. (5) Tapping, and loading up on trucks as required, needs seven men per unit, and handling in the stockyard another two men.

The manufacture of malleable cast iron is likewise easily accomplished in the electric furnace, as the general quality of the steel turnings enables the low percentage of silicon and manganese required to be readily obtained, the reduced percentage of carbon present being dependent on the composition of the charge.

The metallurgical value of the results obtained by the process alter completely when it becomes a question of dephosphorization, which the author has practically accomplished by means of a dual process.

In the first place the steel turnings are melted in the presence of a small quantity of carbon and of a basic oxidizing slag. It is necessary to aim at a critical carburization which must be as high as possible, in order to lower the temperature of working and to facilitate the casting of the metal, while at the same time effecting dephosphorization. About 1 per cent of carbon or slightly more attains this object.

The first-stage dephosphorized metal, containing low percentages of silicon and manganese, is, according to circumstances, either cast into small ingots which are subsequently melted in an open furnace, mixed with the necessary additions of carbon and a desulphurizing slag composed of materials containing exceedingly little phosphorus, or else poured into a second furnace of the bricked-in type, and covered with a layer of anthracite for recarburizing. The synthetic cast iron produced is controlled in respect of its silicon and manganese percentages by the addition of oxides and of a corresponding amount of reducing carbon, in the ordinary way. This mode of working somewhat increases the cost of production during the first phase; and further necessitates, in the second phase, a converting cost equivalent to that of manufacturing ordinary synthetic cast iron. About 1500 kilowatt hours must be allowed for the two operations.

The author concludes this account of the chief metallurgical results obtained with synthetic cast iron by describing an alternative process which he has been led to contemplate in connection with the manufacture of steel from steel turnings.

As in the preceding example, the steel turnings are melted in an open furnace fed by the charge, but the slag, instead of being oxidizing, is desulphurizing, and the quantity of carbon introduced with the charge should be sufficient to reduce the oxides in the turnings and to carburize the metal to an extent distinctly above the percentage of carbon sought in the steel, so as to facilitate the pouring of desulphurized metal and to allow of an oxidizing working in the second stage of the operation.

For example, if a steel with 0.5 per cent of carbon be required, the metal in the primary furnace may be poured at 1.5 per cent of carbon. It will, as has been said, have been freed from sulphur during melting.

The secondary operation, which can be either in an open-hearth furnace or in an electric furnace, refines the metal and brings it to the required carburization, while at the same time dephosphorizing it. It then remains to bring the metal to the proper carbon content in the ordinary way.

The production of synthetic cast iron during the war has been considerable. It is not possible to estimate at the moment how much has been produced at works other than those administered by the Keller Leleux Co. at its works at Livet, Nanterre, and Limoges. The production of these three works alone exceeded 150,000 tons during the period of the war.

Directly after the specifications for projectiles of semisteel appeared, the author took steps to produce a metal complying with the conditions laid down by the French ordnance department. By November, 1914, such an iron had been produced and investigated, corresponding with the following composition: Carbon, 2.9 per cent; silicon, 1.75 per cent; manganese, 0.50 per cent; sulphur, traces; phosphorus, 0.05 per cent. The tensile strength of this iron was as high as 71,000 pounds per square inch in some cases, exceeding ordnance department specifications by 35,500 pounds.

Costs Show Further Increase

FOUNDRYMEN who have been forced to advance the price of castings to an unprecedented level, under pressure of advancing costs, owe it to themselves, their customers and their employes to present the basis for such action. With this thought, the Thomas Devlin Mfg. Co., Philadelphia, which produces malleable, gray iron, brass and steel castings, has prepared an analysis which shows an increase over last February. The labor cost over a period of years is taken as a foundation upon which to establish the percentage of increase in cost. Five groups or classifications are studied and compared, to arrive at the percentage of increase between 1909 and 1920. This is secured in the manner indicated in the accompanying table.

	1909 Molders received	$18.00 per week	60 hrs. =	$ .80	per hr.	
May 1,	1920 Molders (Day)	48.00 per week	48 hrs. =	1.00	per hr.	advance of 233%
	Molders (Piece)	56.28 per week	48 hrs. =	1.17	per hr.	advance of 290%
	1909 Machinists	18.00 per week	60 hrs. =	.30	per hr.	
May 1,	1920 Machinists	38.00 per week	48 hrs. =	.79⅙	per hr.	advance of 164%
	1909 Tool Makers	18.00 per week	60 hrs. =	.30	per hr.	
May 1,	1920 Tool Makers	43.00 per week	48 hrs. =	.8956	per hr.	advance of 200%
	1909 Laborers	9.00 per week	60 hrs. =	.15	per hr.	
May 1,	1920 Laborers	25.00 per week	48 hrs. =	.52	per hr.	advance of 246%
						1133

1133 per cent, the sum of the increases, divided by 5 gives an average advance of 226 per cent.

In 1909 this company sold castings at 6 cents per pound. The materials used cost a fraction less than 1 cent per pound, and deducting a profit of 10 per cent, there was left a balance of about 4½ cents to pay for molding, melting, cleaning, finishing, assorting, and all overhead expenses.

Utilizing the percentage figure obtained as previously shown, the company estimates its new selling price in the following manner:

226 per cent x 4½c =
$0.1017 increased cost of labor.
0.0549 cost with 10% profit off 1909 price of 6c.
0.0200 increased cost of iron since 1909.
0.0016 increased cost of superintendence.
0.0172 profit of 10 per cent.

$0.1944 selling price 1920.

Therefore, the company now must charge its customers 19.44 cents per pound instead of 6 cents in order to cover the actual increase in cost of labor and materials. This figure does not include war taxes and other items which have increased in proportion.

It is explained that iron, coal, coke and other raw materials have advanced from 100 to 200 per cent, and that new taxes, other items unknown in 1909 have entered to increase this total. The company has issued a form letter setting forth the facts as stated.

Electrical Melting of Alloys---VIII

Induction Type Furnaces Offer Advantages in Melting Certain Alloys, But Possess Limitations Which Prevent Their Use for High Lead or Copper Alloys

BY H W GILLETT

IT HAS been shown that volatility of zinc is the factor that makes the common types of electric steel furnace inapplicable to brass Therefore the development of the rocking indirect arc type and the granular resistor reflected heat type both specially designed for brass was necessary to cover the nonferrous field There is another electric furnace specially designed for brass which departs far more from the beaten track of steel furnaces and is highly successful in its own special field This is an induction furnace the Ajax Wyatt* made by the Ajax Metal Co Philadelphia

It has been pointed out repeatedly that the nearer the approach to internal heating in an electric furnace and the more compact the furnace the less waste space it contains and the less the wall area the more efficient it is The Ajax Northrup as has been stated in the article on crucible furnaces attains this idea but does it only by the use of high-frequency current which not yet is commercially available at reasonable cost The Ajax Wyatt approaches this idea closely and uses ordinary alternating current Internal heating is attained by the use of the metal itself as the resistor, making it the secondary of a transformer in an induction furnace Ordinary or horizontal ring induction furnaces long have been known and have been used for melting steel but they consist of a maximum of wall and a minimum of hearth capacity, and hence are inefficient through thermal leakage even though they generate heat in the metal itself Their use still persists in Germany but they have almost vanished from American steel melting practice Its simplest form is shown in Fig 1 and its construction on the principle of a transformer with one turn on the secondary is shown in Fig 2

Such a furnace will not operate on brass though it will on steel, because the resistance of brass is so much the lower that at a power input sufficient to melt brass the voltage is low and the current high The current in trying to melt brass bronze copper aluminum etc, has to be so high that a phenomenon called the *pinch effect* occurs and prevents the operation of the furnace On nickel and some of its alloys, the resistance is high enough so that the behavior is like that on steel, and a furnace much like that in Fig 1 was used regularly, in 1919, and still is in use by the Hoskins Mfg Co, on nickel though it probably will be superceded ultimately by a direct arc furnace

When current is passed through a conductor the conductor tends to contract Solid conductors cannot contract but those which are liquid can This contraction increases with the square of the current and at the high currents required in an induction furnace working on nonferrous alloys the ring of molten metal in the secondary is actually *pinched* off, so that there is no contact between the pinched off ends and therefore no more current flows The ring has to be forcibly held together in order to continue heating, and it cannot be forced to stay together in an induction furnace with a horizontal ring open at the top

By closing the top of the secondary ring so that the metal is confined by placing it vertical instead of horizontal and by providing a reservoir at the top of the ring the hydraulic head of molten metal in the reservoir can be made to exert enough pressure to counteract the pinch force, hold the metal together in the secondary and thus allow heating to proceed

When the metal in the secondary is thus confined the pinch force cannot separate the metal, but it can move it It sets up a strong circulation which makes it possible to heat a much larger mass of metal than can be held in the secondary ring itself The automatic circulation which draws molten, but cool, metal into the ring, heats it and pumps it out It will be seen that this circulation insures thorough mixing of the charge

In the simplest form of the vertical ring induction furnace the metal within the furnace has the shape of a signet ring with the signet, representing the hearth, held uppermost. The loop of the ring then represents the secondary loop

As the induction furnace is a trans-

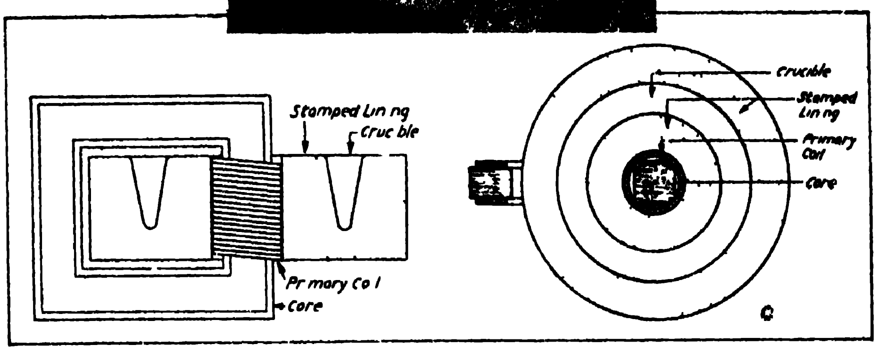


FIG. 1 HORIZONTAL RING FORM OF SMALL INDUCTION FURNACE TILTED TO SHOW POURING POSITION FIG. 2—VERTICAL AND HORIZONTAL CROSS SECTIONS OF SINGLE RING INDUCTION FURNACE

Wyatt J R U S Patents 1201671—1235628 1235629—1235630—1312069 1313571 (The furnace is also licensed under the following U S patents
Schneider U S Patents 761920—769330
Kjellin F A U S Patent 682088
Hering C U S Patent 988936)
Clamer G H Melting Brass in the Induction Furnace Jour Am Inst Metals Vol 11, 1917 p 385
Clamer, G H Ajax Wyatt Electric Furnace Metal Ind Vol 17 1919 p 362
Blakeslee R N Jr, Operating Brass-Making Induction Furnaces Electrical World Vol 74, 1919, p 642
Kenyon O A, Developments in Brass Melting Iron Age Vol 105 1920 pp 810 880 Brass World Vol 16 1920 p 87

former with a molten secondary, and has the usual transformer core within the secondary loop, care must be taken, just as in a transformer, to avoid magnetic leakage Hence, instead of the secondary loop having a circular cross section, it is flattened out into a loop, of a rectangular cross section, the better to enclose the core By this means the power factor can be brought up to a better figure than in a horizontal ring-type furnace, which does not allow as effective prevention of magnetic leakage Foley* has worked with furnaces of this type at the Bristol Brass Co, Bristol, Conn, but, according to recent advices from that firm, the Foley furnace is not yet on a commercial basis, so only the Ajax-Wyatt, which is, will be considered here

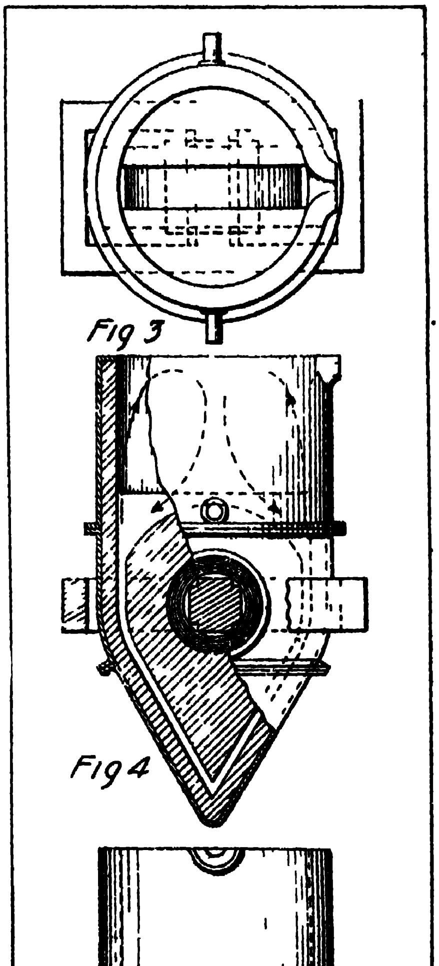


FIG 3—CROSS SECTION OF AJAX-WYATT TYPE FURNACE FIG. 4—SECTION WITH ARROWS SHOWING THE CIRCULATION OF MOLTEN METAL FIG. 5—ELEVATION OF AJAX-WYATT FURNACE

Uses Angular Loop

In the Ajax Wyatt, instead of the secondary loop being in circular or semi circular shape it is in the shape of a V with the hearth making the connection across the top By having this acute angle in the loop electromagnetic repulsion at the vertex sets up a still greater circulation, due to what is termed the *motor effect* Therefore, the design of the Ajax Wyatt becomes as is shown in Figs 3 4 and 5 The arrows in Fig 4 show the circulation of the metal Figs 6 and 7 show the first furnace to be built in a commercial size, operating at the Ajax Metal Co plant on ingot and slab metal in January 1916

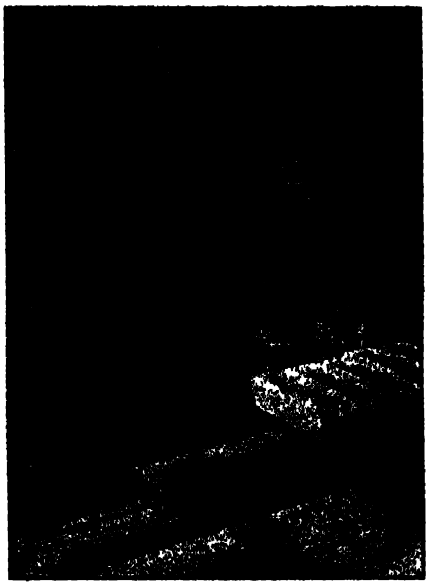


FIG 6—FIRST COMMERCIAL SIZE INDUCTION FURNACE

The furnace shown the writer believes, was the first electric brass furnace in America that melted metal for commercial purposes and was of a type that continued in commercial use Figs 8 and 9 show the most modern styles The Bridgeport Brass Co has modified the furnace somewhat, placing a special door in the back of the furnace for skimming and charging just above the metal level, the body of the furnace being somewhat taller than in the usual Ajax form

This furnace did not come into being in a jiffy. It was preceded by a vast amount of work by the Ajax Metal Co on the Hering furnace. Hering, who had discovered the pinch effect, set to work to utilize it in a furnace By passing current through molten

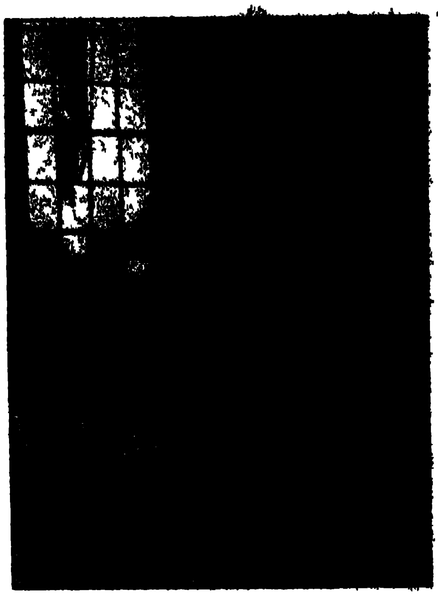


FIG 7—SIDE VIEW SHOWING CONTROL PANEL OF SAME FURNACE

metal in tubes, holes in the refractory, below a hearth, he opposed the pinch force by a hydraulic head and obtained circulation However, a solid electrode has to be used to carry current to the resistor tube In the largest furnace built, shown in Figs 10 and 11, each resistor tube ran at about 3 volts and 11,000 amperes. To carry such a current in solid electrodes, the electrodes had to be made of copper and water-cooled to keep them solid To reduce losses in the leads, the transformer had to be fastened directly into the bottom of the furnace There are great difficulties in the design of a suitable transformer which will do the work and yield satisfactory results on electric furnaces designed to be operated on any type of nonferrous metal

Hering furnaces were thoroughly tried out by the Ajax Metal Co,** the Scovill Mfg Co and the National Cash Register Co in 1914-1915 They gave low metal losses, as nearly half the power supplied never reached the resistor tubes The power consumption was excessive due to the heat expended in the transformer and in the great

*Foley C B British Patent, 114854 of 1916
**Hering C A, Practical Limitation of Resistance Furnaces the Pinch" Phenomenon Trans Am Electrochem Soc Vol 11 1907, p 329
The Working Limit in Electrical Furnaces due to the Pinch' Phenomenon Trans Am Electrochem Soc Vol 15 1909 p 255
Fitzgerald, F A J, Discussion, Trans Am Electrochem Soc Vol 15 1909 p 278
Hering C, U S Patents 988936 999720 1105656
Hering C, A New Type of Electric Furnace, Trans Am Electrochem Soc Vol 19 1911, p 255
Electric Furnace for Molten Materials, Met. and Chem Eng, Vol 9, 1911 p 371
Ideals and Limitations in the Melting of Non-ferrous Metals, Jour Inst Metals (British) Vol 17, 1917, p. 243
Advantages of a Small High Speed Electric Furnace Met and Chem Eng, Vol 11, 1913, p 183
Clamer G H, The Hering Electric Furnace for Commercial Brass Melting Trans Am Inst Metals Vol 7 1913, p 350
Clamer, G H, and Hering, C Electric Brass Melting, Trans Am Inst. Metals, Vol 8, 1914, p. 270
Clamer, G. H, and Hering C The Electric Furnace for Brass Melting, Vol 6, 1912, p. 25

FIG. 8—TRUNNION TYPE AJAX-WYATT FURNACE OF 60 KILOWATT RATING

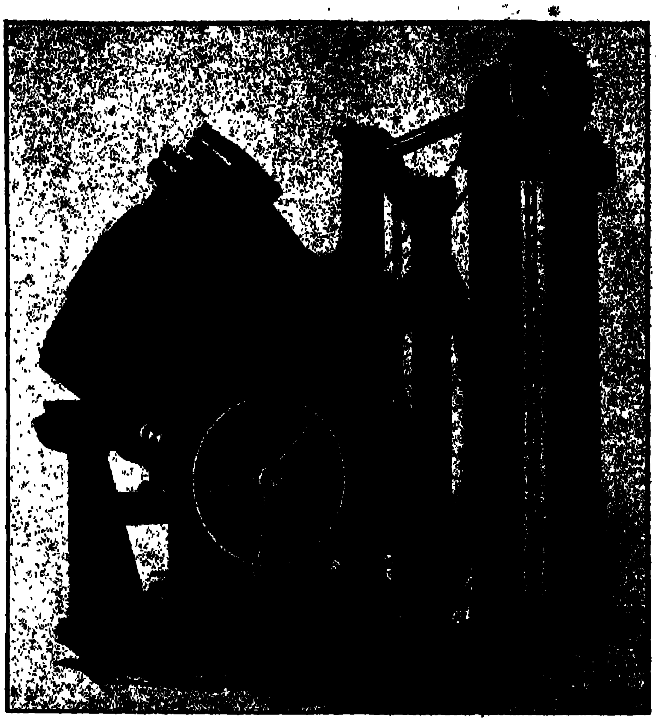


FIG. 9—NOSE TILTING TYPE ADAPTED TO POURING INGOTS DIRECTLY

amount of cooling water it was necessary to use to keep the copper electrodes solid and to prevent their melting back to the water and causing an explosion. On four tons of manganese bronze, containing about 40 per cent zinc, melted in a 100 kilowatt furnace, pouring 625 pounds per heat, heated to 1010 degrees Cent., in 21 1-3 hours, continuous operation, the furnace being fully hot at the start, the power consumption was about 400 kilowatt hours per ton.

After the Hering furnace had been reluctantly discarded, the Ajax Metal Co. eliminated the electrodes, joined two resistor tubes together into the secondary of an induction furnace, and thereby avoided, in the Ajax-Wyatt, the electrode and transformer troubles of the Hering.

The Ajax-Wyatt furnace consists of a cylindrical chamber into the bottom of which open the two legs of the V-shaped resistor, or secondary, loop. The laminated iron transformer core is a three-legged type. The central leg, on which the primary coil is wound, is within the resistor loop. The primary coil and the transformer are enclosed in a casing and cooled by a blast of air from a small blower.

The furnace was first made in a 30 kilowatt size, pouring about 300 pounds per heat, but the standard size is now 60 kilowatt pouring about 600 pounds per heat. They take 220 volt, single phase power and, on a 60 cycle line, have a power factor of 81 for the 60 kilowatt and 87 for the 30 kilowatt, a highly satisfactory figure for an induction furnace.

Since the heat is generated in the metal itself the furnace does not have to be insulated against temperatures above the pouring temperature of the alloy melted. An excessively thick lining therefore is not required. The furnace is extremely compact and takes little floor space when its output is considered.

The furnace is lined with high temperature asbestos cement, which must be uniformly mixed and tightly rammed. Experiments with refractories on the order of crucible mixtures, with which it is hoped to be able to handle highly leaded alloys, are under way. The resistor loop is initially formed by ramming up the lining about a brass casting which is left in.

After slow and careful air and overdrying, to drive out moisture and set the cement, the hearth is heated by the flame from a gas torch, molten zinc poured in and power applied, at a low voltage. When the brass casting has heated, alloyed with the zinc and melted, full power is applied, brass scrap and copper are added to bring the metallic contents to the proper composition, and the furnace is then in action. When the furnace is shut down, all the metal is drained from the resistor, since if it is allowed to freeze

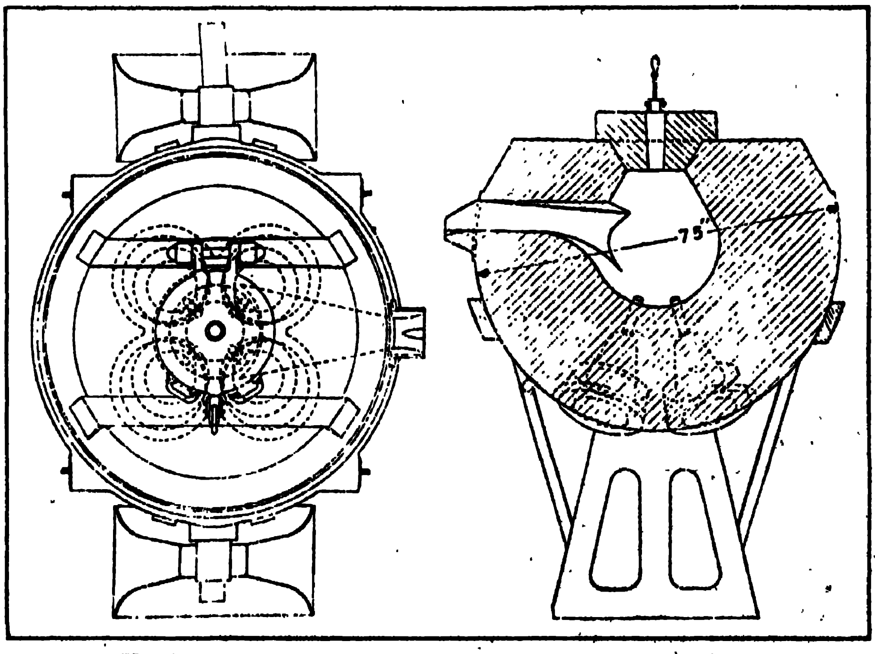


FIG. 10—PLAN AND ELEVATION OF HERING RESISTANCE TYPE FURNACE

in it, the lining will be cracked and ruined. In starting after a shut-down, the furnace is warmed by a gas flame, molten zinc is poured into the resistor, and scrap brass is fed in as in the original start.

If suitable precautions are taken in lining, drying, and operating the furnace, good lining life is obtained. The 300-pound size runs from 75 tons to an average of 250 tons, and sometimes gives as high as 3[illegible] tons at the Bridgeport Brass Co., and the 600-pound size at the American Brass Co. averages 400 to 600 tons on 60/40 or 70/30 brass, with some linings lasting for over 750 tons. The lining stands up less well against alloys high in lead, but the American Hardware Co., melting an alloy with 30 per cent zinc, and 5 per cent lead, averaged about 60 tons per lining in the 300-pound size.

The makers in the past have not advocated the furnace for alloys of over 3 to 3½ per cent lead but now state that it will handle up to 6 per cent lead, though detailed performance figures on such alloys are not available.

Leaks Are Detrimental

Cracks in the lining of the resistor tube that allow metal to seep through and reach the casing so as to short circuit the secondary through the casing, are fatal, and lead will ooze out through a hair crack that other metals would not pass. The relining cost for the 60 kilowatt is given by the makers as $200 under 1920 prices.

The furnace operation is simple, the simplest, in fact, of any electric furnace. When the switch is closed, the furnace at once operates at its full load and continues to operate steadily and with almost no variation, save the slight change due to difference in resistance of the metal in the loop at different temperatures. There are no surges. Temperature control is absolute. There is no heat storage at temperatures above that of the charge, so there is instant response in temperature to the throwing the power on or off.

If the heating is allowed to continue so far that the metal in the secondary loop reaches the actual boiling point of zinc in the alloy, bubbles of zinc vapor form in the tube, this alters the resistance of the secondary, and the ammeter needle starts to kick. This means that all the metal the furnace has to work on is heated up. It occurs only when a charge of scrap has bridged over in the furnace chamber and needs poking down, or when the metal has been allowed to get slightly hotter than it should be before pouring.

FIG. 11—HERING FURNACE IN OPERATION—NOTE THE PIPING NECESSARY TO WATER COOL THE ELECTRODES

The metal losses are low. The Bridgeport Brass Co. gives its average net loss on yellow brass as 0.50 per cent. Charges of all yellow borings that gave a net loss of 5 per cent in crucibles, gave, in a week's run in an Ajax-Wyatt one of 2.7 per cent.

There is no automatically reducing atmosphere in this furnace as there is in the other types, for there are no carbon parts in the furnace. Therefore, it is desirable to keep a layer of charcoal over the metal to prevent oxidation, though this is not always done as zinc vapor is heavier than air, lies in the furnace chamber and excludes air to some extent. A layer of zinc oxide builds up about the upper part of the hearth and has to be chipped out with a high-speed tool steel pneumatic chisel every two or three days to keep the accretion from cutting down the hearth capacity. The quality of the metal is excellent. The rolling mills pour directly into the molds. There is a special nose-tilting type for this, and the trunion type also is used, either by moving the mold so as to follow the spout or by picking the furnace up with a crane and pouring it like a ladle.

The Bridgeport Brass Co. obtains better shrinking, less crop, less scrap, better surface and more uniform metal from this type furnace. This firm has torn down its stacks and gone definitely and wholly over to electric melting. It advertises this fact and also has offered its reserve stock of crucibles for sale. In its advertisements it states that electric melting is the greatest advance in the brass industry for 140 years. Since going to electric melting it has had no cases of brass shakes, and fewer severe burns.

Mixing is Thorough

The thorough mixing of the charge by the circulation of metal in this furnace is one of its greatest advantages. The American Brass Co. states that in its 600-pound furnaces, 100 pounds of zinc is mixed in with absolute thoroughness in five minutes with no stirring other than that done by the furnace itself. Analyses from top, middle and bottom of ingots from the Ajax-Wyatt often reveal no difference outside the limits of analytical error.

Out of 52 heats on an alloy of 62 per cent copper, 38 per cent zinc, the difference in copper content between top and bottom was within 0.20 per cent on 19, and within 0.50 per cent on 46. Outside of two heats which showed a variation of slightly over 1 per cent, all the heats came within 0.75 per cent copper.

The thermal efficiency of the furnace is the highest shown by any type of electric brass furnace. The production is not high because of the small size and low power, but this is not a real drawback because the compactness of the furnace and its ease of control will allow the installation of a battery of three or four furnaces in the space occupied by a 1500 or 2000-pound furnace of other types, and their operation by as few men. The furnaces are small but they are not toys.

In average 24-hour operation of the 300-pound furnace at the Bridgeport Brass Co. on 70/30 or 60/40 brass, the output is a little under three tons per furnace per day at 250 kilowatt hours

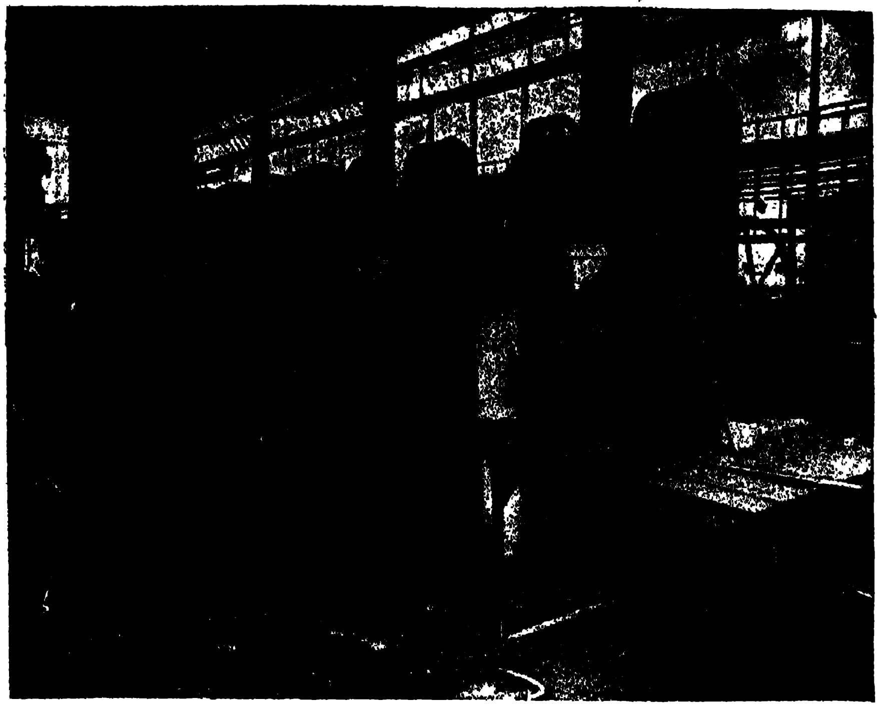


FIG. 12—POURING SIDE OF A BATTERY OF INDUCTION FURNACES AT THE BRIDGEPORT BRASS CO. PLANT

per ton. At the American Hardware Co., the power consumption was 245 kilowatt hours per ton. Under test conditions, the output can be raised to more than three tons and the power consumption dropped to less than 210 kilowatt hours per ton.

In the 600-pound furnace, on yellow brass, the American Brass Co. on 24-hour operation under most favorable conditions, gets a power consumption of less than 175 kilowatt hours per ton, which would correspond to 200-220 kilowatt hours per ton in average operation, and to outputs of 6 to 7½ tons per furnace per day. Few other furnaces approach so good a power consumption. As with every other electric furnace, operation on charges of all oily yellow borings can be made only at a poorer power consumption figure, a decreased output, and greater attention than on clean, solid metal.

Application Limited

The furnace has every advantage an electric furnace can have with the exception of versatility. It probably is unexcelled for operation on yellow brass 24 hours per day. It can handle alloys with only about 10 per cent zinc, as the resistance of molten alloys from 10 to 40 per cent zinc is not greatly different, and an auto-transformer in the primary will give the needed difference in voltage. Alloys approaching pure copper would need a resistor of different cross-section, and the power factor would not be so good.

This limitation, coupled with that due to the yet unsolved problem of refractories suitable for handling alloys high in lead, makes the furnace incapable of handling all the alloys of the average jobbing shop, and less applicable to red brass or bronze than to yellow. Another limitation lies in the fact that only the contents of the hearth are poured, as the metal in the loop and enough more to make contact between the legs must be retained between heats, 75 pounds in the size pouring 300 pounds and 125 pounds in that pouring 600 pounds. If the residual metal can be worked into the next charge, successive heats of different alloys can be made, but this is the more difficult as the alloys vary more widely. The furnace therefore is best fitted for long straight-away runs on the same alloy, and is poorly suited to successive runs on different alloys.

A serious condition arises due to the fact that the metal in the loop will freeze if power is off about 20 minutes, or perhaps sooner if the power should fail just after charging. Since a freeze-up ruins the lining, interruptions to the power supply, as from poor central station service, are serious.

If the furnace is to be used on single-shift operation, or shut down at night or over Sunday, it may be drained from all the metal in the loop. However, this involves delay and trouble in starting afresh. The other alternative is to leave the metal in the loop and reduce the voltage, by using the proper voltage tap on the transformer supplying power to the primary, so that just enough power is drawn to keep the contents molten. In that case it is necessary to have a man with the furnaces to dump them and save the linings in case of a power stoppage. The power thus used while the furnace is idle increases the cost of single-shift operation.

Cost is Moderate

However, even such operation does not bring the power cost per ton to an impossible figure. Collins* figures that the Ajax-Wyatt can melt, on 8-hour operation, at 300 kilowatt hours per ton, while under the same conditions

*Collins, E. F., Melting Some Nonferrous Metals and Their Alloys in the Electric Furnace, Foundry, Vol. 47, 1919, pp. 284, 329.
Jour. Cleveland Eng. Soc., Vol. 11, 1919, p. 293.
Metal Ind., Vol. 17, 1919, p. 221.
Chem. Met. Eng., Vol. 21, 1919, p. 673.

FIG. 13—BATTERY OF FURNACES AT THE SAME PLANT USED TO SUPPLY THE SAME ALLOY DAILY FOR BILLETS

it takes 400 kilowatt hours per ton in a General Electric furnace. A 600-pound Ajax-Wyatt would produce about two tons in eight hours and a 1-ton General Electric not over six tons. Collins argues that the $1 per ton saving made by the Ajax-Wyatt over the General Electric, with power at 1c per kilowatt hour, is more than balanced by the lower labor cost in the larger General Electric furnace, which labor saving he assumes to be $1.25 per ton, giving a net saving of 25c per ton in favor of the General Electric. It appears to the writer that, by staggering the heats the same crew could handle three Ajax-Wyatt furnaces that could handle one 1-ton furnace of any other type. Moreover, if the power cost is 1¼c per kilowatt hour instead of 1c, the whole $1.25 per ton advantage assumed by Collins is wiped out. The superior mixing of the charge in the Ajax-Wyatt should not be forgotten in any such comparison.

It is the necessity for guarding against a freeze-up, the inability of the furnace to handle alloys high in lead or high in copper, and the difficulty in changing from one alloy to another, rather than the cost of power for keeping the residual metal hot at night, or the labor cost, that makes the Ajax-Wyatt not generally applicable to plants. This is true more especially of jobbing shops, operating only one shift.

The furnace is best adapted for use on yellow brass in rolling mill work, or in melting yellow scrap for casting into ingots, and its use is mainly confined to such work.

The prices of the standard furnaces, complete, save for step-down transformer from line voltage to 220 volts, were given, on March 29, 1920, as follows:

40 kilowatt	$5500
60 kilowatt	6500
80 kilowatt	7500

The 220-volt transformers will increase the total cost a few hundred dollars.

Larger Size Needed

The present sizes of the Ajax-Wyatt furnace are useful, but there is an undoubted need for furnaces of larger capacity. The most power that can be utilized by a single secondary loop is thought to be about 70 kilowatts, as the difficulty of getting a good power factor increases with increase in the size. Experimental work now is under way on a multiphase furnace, which probably will use about 140 kilowatts and have an output of at least 1250 pounds per hour. The Bridgeport Brass Co. also is experimenting on a larger size, single resistor, loop furnace. One taking 80 kilowatts pouring 1500 pounds, and showing around 205 kilowatt hours per ton in regular 24-hour operation on yellow brass, and having a power factor of 60 to 65, has been built. It is hoped to improve the power factor.

The Bridgeport Brass Co. reported in the middle of May that the 80 kilowatt furnace had so far turned out 925 tons on one lining without a stop and was still performing as well as when first started. On this showing, it appears that the lining cost per ton will go down to an extremely low figure in the larger Ajax furnaces.

The Ajax-Wyatt covers the field of alloys high in zinc to a rather similar extent that the stationary indirect arc type does for alloys low in zinc. The two types together nearly cover the field, but even a battery of the two types is somewhat lacking in versatility so that there still is need for such furnaces as the reflected heat or reverberatory and the rocking indirect arc types.

The application of each type to the work for which it is best fitted will be more thoroughly discussed later.

How and Why in Brass Founding

By Charles Vickers

Formulas for Pump Liners

We would like to obtain a formula suitable for pump liners weighing from 200 to 800 pounds. Also red metal mixtures containing scrap metals.

The following mixtures will make a good lining metal: Copper, 84.75 per cent; tin, 9 per cent; lead, 5 per cent; nickel, 1 per cent; phosphor copper, 0.25 per cent. Melt the copper under 2 inches of fine charcoal. When liquid the metal should not *boil* under the charcoal as this denotes the presence of gases which will produce spongy liners. Copper that boils should be ingoted, and a fresh start should be made with new copper; the gaseous copper can be used for small castings of red metal containing plenty of zinc. The copper being properly melted will be quiet and sky blue in color when molten. Add the nickel as an alloy of 50 per cent copper; 50 per cent nickel. Then follow with the phosphor copper; allow the heat to stand a few minutes, add the tin and then the lead last of all.

Use good red scrap for making red brass. All scrap may be used, or part scrap and part new metal. Thus if 50 pounds of red machinery or valve scrap is made part of the charge, the new metal can be as follows: Copper, 42 pounds; zinc, 4 pounds; lead, 4 pounds. This will produce a good alloy.

Brass Sleeve Mixtures

Would you kindly advise us what you would recommend as the best specifications to be used in brass sleeves seven inches in length, and over.

The following alloy is excellent for brass sleeves that are used for bearings: Copper, 86.25 per cent; phosphor copper, 0.5 per cent; tin, 8 per cent; lead, 4.25 per cent.

For other uses than bearings, but where a good composition is required, the following alloy is suitable: Copper, 88.50 per cent; tin, 5.50 per cent; zinc, 3.50 per cent, and lead, 2.50 per cent. This alloy is softer than the other.

Formulas for Automobile Brass Castings

We desire to obtain brass mixtures suitable for general automobile castings, for housings and nuts, also the formula for an acid for cleaning brass castings without rattling them.

For bearings for automobiles use the following alloy: Copper, 80 per cent; tin, 10 per cent; lead, 10 per cent; phosphorus, from 0.05 to 0.25 per cent. For red brass use copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent; lead, 5 per cent. For yellow brass, use copper, 62 per cent; zinc, 36 per cent; lead, 2 per cent. For aluminum alloys use No. 12 aluminum.

A dip to remove sand from brass castings is compounded as follows: Nitric acid, 1 part; muriatic acid, 6 parts; water, 2 parts. Immerse the castings and leave in the dip 30 minutes, then remove and rinse in cold water, then in hot water; dry in sawdust in a wood lined tumbling barrel.

Correcting Defects in the Bronze Bushings

We are sending two samples of metal for inspection which may be designated as the small and the large sample. The small sample is cut from the riser of a 300-pound bushing. The riser is 1-inch diameter and the sample is a cross section cut therefrom. It is filled with holes perpendicular to the length of the riser and located around the center. We would like to learn the cause of these holes. The bushing is molded upright, and its dimensions are length, 4 feet; diameter, 7 inches; thickness of metal, 1⅛ inches. The mixture is 88-10-2 and the metal is melted in a gas-fired furnace, the casting being poured by two sprues located directly on top of the bushing, on opposite sides, so the metal drops to the bottom of the mold. There are two risers also on top of the bushing end, also opposite each other. The large sample is cut from the gate of a 60-pound half bearing, the sprue being 9 inches high and 2¼ inches in diameter. The molds are made of core sand, well baked and vented, and the metal is kept covered with charcoal while being melted.

The holes in the small sample are due to shrinkage of the riser, the metal from which has fed down into the bushing. These holes are likely to extend into the casting although nothing is said about this. The remedy is to enlarge the risers. If the castings are clean the top gating can be continued, but instead of dropping the metal directly into the mold from the crucible, it would be much better to put a cope on top of the present mold top. Bring the sprues up straight as at present and in the cope which covers the sprue tops, place a heavy ball as a feeder to the sprue. This ball must not cut through the cope. Connect the sprues to the pouring gate in the cope by a horizontal channel, and have the sprue top in the added cope set off a few inches from the termination of the straight sprue leading to the mold cavity. This breaks the fall of the metal and permits the sprue to be kept filled while pouring. The risers should be placed 1 inch away from the sides of the bushing. They should be 3 inches in diameter at least, and should connect with the side of the bushing by a square gate about 2 x 2 inches and 2 inches deep. Cut away the sand forming the angle between feeder and gate in the cope so the metal can feed without chilling. Carry the feeders through the added cope, and fill them with hot metal held especially in a small crucible.

This will produce a sound casting, but many founders would prefer to gate such a casting at the bottom, then at one or more places up the sides, and control the shrinkage by means of heavy feeders.

The metal appears to be free from gas and the melting is not at fault. An oil or gas-fired furnace carefully run with a slightly reducing flame until the metal is melted, then warmed up by a hotter flame, will produce as good metal as the crucible. The defect in the larger sample is caused by shrinkage at the gate. It is a mistake to make a triangular gate. The gate is 1¾ inches wide at the bottom, and it is 2½ inches high tapering to a point. Make it square, have it the same width, but 1½ inches deep and 1½ inches wide at the top. Also, connect the sprue to the gate in the cope by a deep fillet, eliminating the angle between sprue and gate, also fillet the sides of the gate at its connection with the casting. Do not pour the metal directly into this heavy sprue, which also forms the riser. Provide a pouring sprue placed about 4 inches away from the present sprue. Make this pouring sprue 1 inch in diameter and 6 inches high and connect to the large feeder by a gate. Carry the riser up 4 inches higher than the sprue top by means of a bushing. When the sprue is filled with metal, cover with sand, bed on a weight, then slowly fill up the riser. Do this slowly using hot metal, and the trouble will be eliminated.

Clock Pivot Mixture

We have a number of pivots to make which require to be hard as they are used in connection with clock work and revolve on sapphire jewels. We are using an alloy consisting of copper, 73.50 per cent; tin, 18.50 per cent, and zinc, 8 per cent, but after several years use the points wear off. Can you advise a mixture that will be harder, but not brittle?

If the alloy containing 18.50 per cent tin and 8 per cent zinc is too soft for the service to which it must be put, it is hopeless to experiment further with alloys of copper and tin, and the alloys of copper and zinc will also be too soft. An entirely different alloy will be required and the following mixture is suggested: Copper, 66 per cent; nickel, 24 per cent; aluminum, 10 per cent. First melt the copper and the nickel together, putting the nickel in the bottom of the crucible on a bed of fine charcoal; the copper then is filled in, more charcoal is added and the whole melted. When thoroughly liquid, add the aluminum gradually, stir thoroughly ond pour slowly and not too hot.

Extracting Silver from the Native Ore

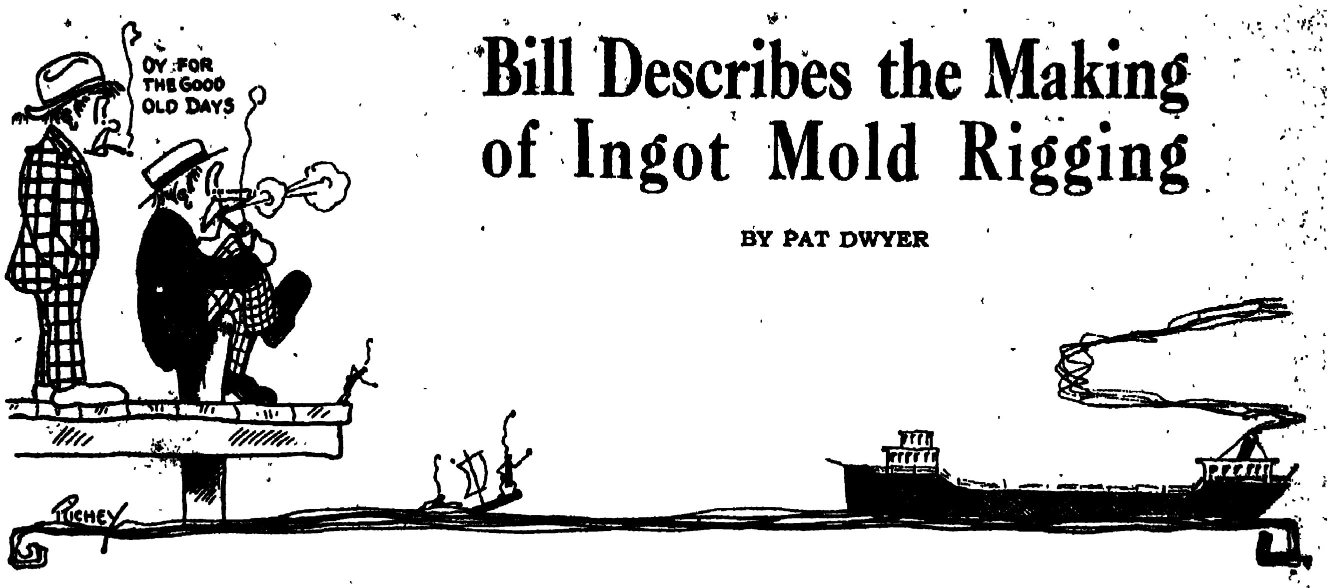
We have some silver ore running about 200 ounces to the ton that we wish to smelt, and we desire to learn if it is practical to do this in a cupola. We have two cupolas the inside measurement of which is respectively 24 and 42 inches. If we can use these cupolas we would like to know what fluxes should be used to extract the silver from the ores.

It will not be possible to recover the silver from the ore by smelting it with coke in a cupola after the manner in which iron is melted. Just what process to adopt for recovering the silver would depend upon the other metallic contents of the ore. If it is a lead ore, it could be treated by a smelting process to produce a silver-lead containing not more than 1 per cent silver. The percentage of silver is limited in order to keep down the silver loss. The silver could then be easily recovered by the Pattinson process, or the Parkes process. The silver-lead ore would require smelting with charcoal to reduce the metals. Amalgamation will have to be resorted to if no lead is present. In one process the ore is roasted with common salt, when cold it is again pulverized and then is washed with water to remove the soluble salts. The residue is put into barrels with water and scrap iron, and the barrels are rotated until the contents are thoroughly mixed when the silver is set free. Mercury is now added to form an amalgam with the silver. The amalgam is pressed and then distilled to remove the mercury, leaving the silver behind. Another method is to finely powder the ore, then mix with common salt, the amount depending upon the proportion of silver in the ore. This mixture is heated by a current of highly heated air which converts the silver to chloride. The treated ore is next washed. The insoluble silver chloride settles as a pulpy mass, which is collected, mixed with a small proportion of copper sulphate and salt and placed in steam heated iron pans. Mercury is now added in the proportion of approximately 150 pounds per ton of pulp, and the mass is ground in the heated pan for several hours at the end of which time the mercury contains all the silver.

Acid Resisting Metal

We would like to secure the formula for a good acid resisting metal.

The following alloy is frequently used for castings that are exposed to acids: Copper, 82 per cent; tin, 8 per cent; lead, 8 per cent, and zinc, 2 per cent.



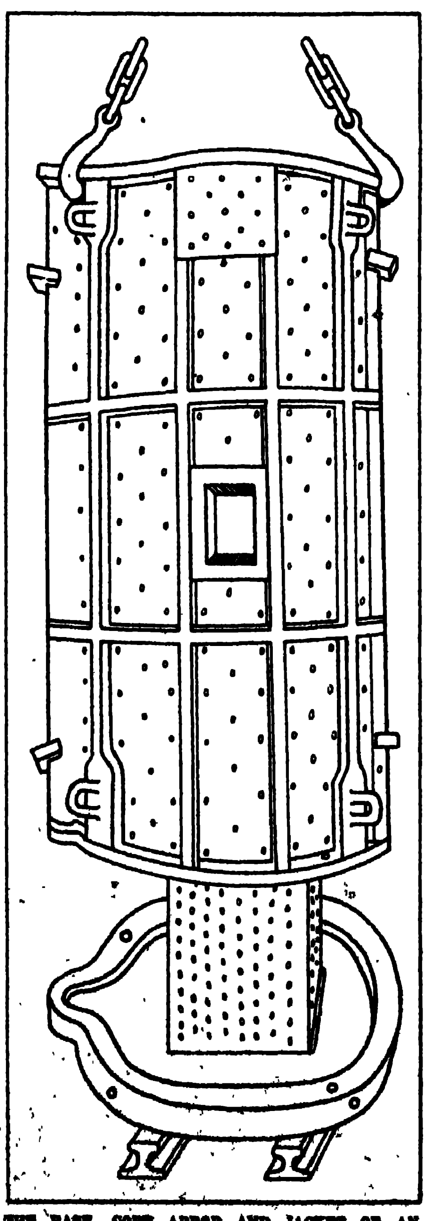
Bill Describes the Making of Ingot Mold Rigging

BY PAT DWYER

WE SAT on the end of a pier watching a huge ore steamer slowly making her way up the harbor. "If I was a young fellow again," said Bill, apropos of nothing in particular, "I would ship on a tramp steamer and see some of the queer and outlandish ports of the world. Just think of walking around the streets of cities that were proud and flourishing communities when Noah was working in the shipyard. Think of the pleasure to be derived from studying the people at first hand. I should like to check some of these things just to satisfy myself that they square with history and also with the productions of the talented gentlemen who are indigenous to Los Angeles, Hollywood and kindred localities."

"If your ambition does not extend beyond the study of human beings," I said, "you do not need to ship on a tramp steamer bound for foreign ports. You can find representatives of every race under Heaven in this city, and if you are interested in history to the extent of wondering what became of the 10 lost tribes of Israel you can set your mind at rest—they are all here, together with a fair representation from the other tribes which were not fortunate enough to get lost in the early days and only found their way over here lately. There are birds here from every port between Hong Kong and Kowloon, and from Callao to Suva and all you have to do to get on the inside track and absorb local color is to rig yourself out in a suit of old clothes, let your whiskers grow, learn to talk without removing the cigaret from your mouth and make a noise like a bunch of garlic."

"I could qualify on all the counts except the last," said he. "I have worn whiskers and old clothes and with a little practice might be able to manage the cigaret—but the garlic—boy, you said a fragrant mouthful. Garlic always reminds me of an experience I had making ingot molds for the open-hearth



THE BASE, CORE ARBOR AND JACKET OF AN INGOT MOLD FLASK—THE COPE IS NOT SHOWN

department of a steel works which employed a large number of foreign workmen addicted to the use of that fragrant vegetable. I have heard the chief chemist say that if some one could devise a way of incorporating a garlic breath with the molten steel as it flowed into the ladle, the resultant product would revolutionize rail making.

"The open-hearth department with ten 50-ton furnaces had an average output of 30,000 tons of steel a month. The ingots weighed approximately three tons each, which meant that 10,000 ingots were poured each month or 333 a day. Since the measure was more or less experimental in nature, it was decided to provide sufficient equipment in the foundry to produce six ingot molds a day. With an anticipated life of even 50 heats for each mold it was expected that this number would take care of the molds broken in service. Approximately 1000 molds were stacked in the yard at the time the experiment was inaugurated and besides that the company operated its own fleet of steamers and could import foreign molds under favorable circumstances.

"Ingot molds can be and are made in many ways and the method adopted in any foundry depends upon several factors; prominent among which are molding and oven facilities, melting and crane capacity, quality of labor available and total tonnage required. Taking these factors into consideration and having investigated several prominent installations it was decided to adopt, with modifications, a method which had been described in THE FOUNDRY a short time previously.

"The principal rigging required comprised an iron pattern and core box; six base plates; 12 complete flasks, split longitudinally or, perhaps I should say vertically, since the molds are all assembled and poured in a vertical position; 12 copes; eighteen 1-piece core arbors and one dummy form on which

to ram the copes. In addition to these, it also was necessary to furnish many little things to which I will refer later.

"The flask was made to conform to the shape of the ingot, with the exception that one side carried a pocket the full length to accommodate a runner. A small square opening also was provided near the center of one side of each flask. The dry sand core holding the heavy staple by which the casting afterward was handled was inserted through this opening after the mold was closed and pushed hard up against the main or upright core.

Making the Flasks

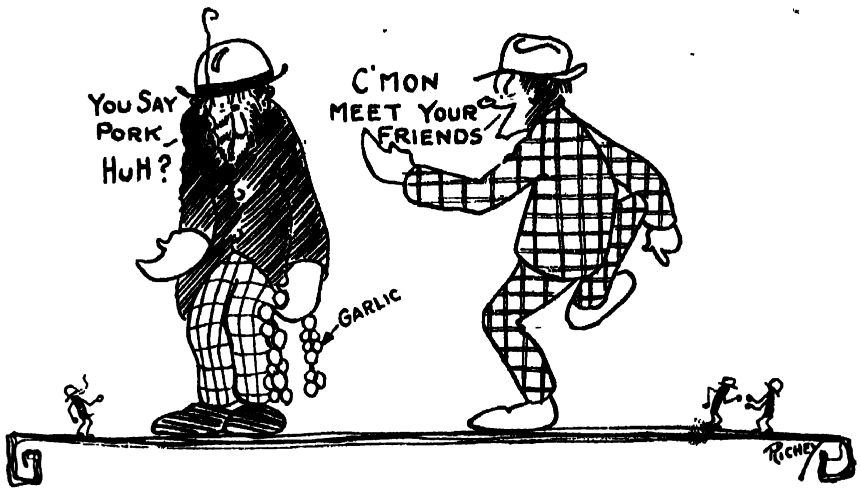
"Two skeleton patterns were made for the flasks, one for the part containing the pocket for the staple core and the other for the plain half. One pattern could have been used for both halves by leaving the pocket piece off and shifting the long side pocket from right to left for every alternate casting but it was figured that since there were so many flasks to make it would be as cheap to make two patterns as to make so many changes. The time element was another consideration. It is common foundry knowledge that two men working on individual patterns will accomplish more than if they are doubled up on one. The patterns were bedded in the floor and the inside lifted by substantial cast iron arbors attached to the copes by long eye bolts. Owing to other work, only two men were available for the ingot-mold job, but by taking a pattern each they turned out two sides for a flask each alternate day.

"The copes were solid one-piece castings, plain on top but having a flange on the face side corresponding in shape to the flange of the flask. The core arbors were also one-piece castings having a large opening at one end and a small opening at the other, and with an average metal thickness of 1 inch. The pattern for the arbor was molded diagonally, that is to say it was laid in the floor horizontally and the parting made along two diagonal corners. This method was adopted to facilitate placing the great number of small cores which were set in to provide a vent for the core when the arbor would be in use. If the pattern had been molded on its flat it would have been necessary to leave sufficient clearance between the cores on both sides for lowering the main core into the mold; and as a result it would have been necessary to punch quite a thickness of metal out of all the holes when cleaning the casting. By molding it diagonally it was possible to leave the little cores the full length. If the main core *did* happen to bear on them a little hard it did no harm but was simply an added assurance that the holes would be clear and open when the casting was cleaned. These small cores were tapered and attached to the mold by inserting a wire nail in a hole which had been provided for that purpose in each of them. The large end of the cores rested on the face of the mold.

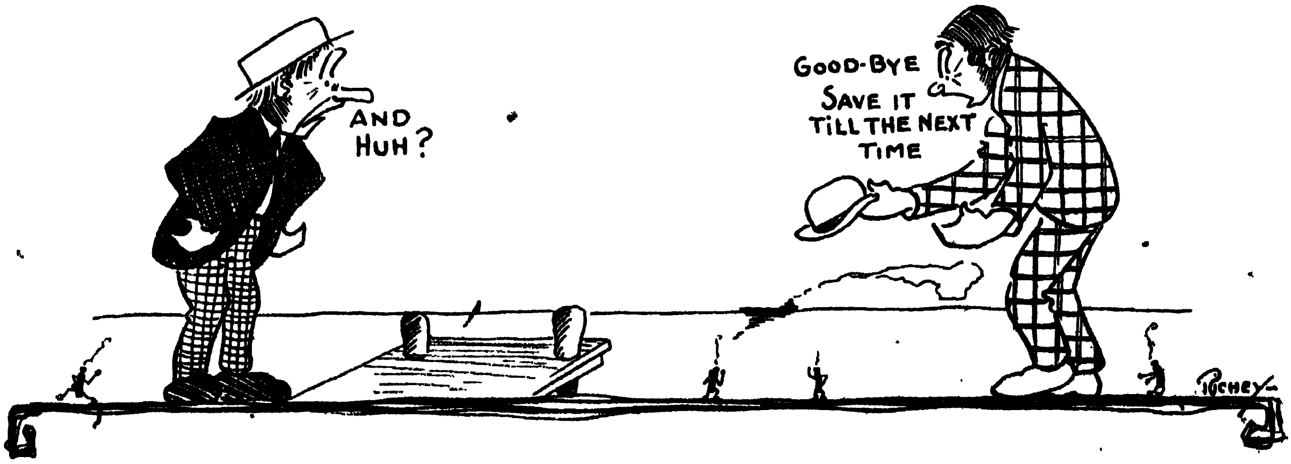
"The bottom plates were substantial one-piece castings provided with four cored 1-inch holes, one at each corner for convenience in handling. The upper face contained two recesses, the first which corresponded in shape to the inside of the flask was about an inch deep and was designed to hold a thickness of sand to form the bottom face of the ingot mold; while the second recess extended almost through the plate and was provided with fitting strips which afterward were machined to fit the bottom or core print of the arbor. These core prints, both on the arbor and on the bottom plate, all were accurately machined to the same dimensions so that the arbors were interchangeable and when in use it was never necessary to roll them over to look for identifying marks. Any one of the arbors would fit any one of the bottoms.

"The lower flanges of the flasks and also the face of the bottom plates which came in contact with the flanges also were machined to a true fit. The pin holes for locating the flasks in their proper relative position when closing the molds were drilled through a jig and therefore the flasks also were interchangeable.

"To provide a pattern it first was necessary to make a master pattern and core box allowing for the shrinkage. The master pattern was molded in dry



AFTER 20 CENTURIES OF WANDERING THEIR BREATH IS AS STRONG AS EVER



THE CALORIES AND HEAT UNITS AND THINGS IN A MESS OF WORDS DO NOT APPEAL TO A HUNGRY MAN

sand, not because it could not have been molded in green sand, as it was only a shell ¾-inch thick, but for the protection the dry sand method afforded against any possible swells on the face of the casting.

Hinged Corebox Used

"The core box, consisting of two halves, was made of cast iron. It was joined together at the back by three hinges and held together in front by a catch which locked by a cam arrangement. One pattern was used for molding both halves. It was necessary only to change the position of the hinges after the first half had been made. The catch was made separately and bolted on after the corebox had been machined and assembled. When in use, the corebox rested on a planed iron plate with a depression in the center corresponding to the depression in the center of the bottom plate which has already been mentioned.

"The pattern also rested on a planed iron plate provided with two pins which served to locate the flasks when they were lowered on for ramming. The pattern was made ¾-inch over the required length to allow for a brass stripping plate. After each mold was rammed this plate was clamped to the lower flange until the mold had been lifted about a foot. The clamps then were knocked off and the plate allowed to drop back into position for the next mold. Considerable trouble was experienced at first in making the molds. The pattern was not anchored because it was considered that the combined weight of the pattern and plate would be sufficient to overcome the attraction of cohesion between the pattern and the sand forming the mold. Experience proved that such was not the case. In attempting to lift the jacket the pattern would come with it and it was necessary to strike the latter several times with a heavy wooden mallet before it would drop to its place.

"The trouble was cured by attaching two sections of 80-pound rail to the bottom of the plate supporting the pattern and then anchoring the ends of the rails in the concrete walls of the pit in which the molds were made. The pattern was bolted to the plate through four light lugs and to offset any possibility of these lugs breaking it was decided to employ additional safeguards. Accordingly a 1½-inch bolt was made long enough to extend from the top and through the center of the pattern to below the rails. A washer and nut were placed on each end and it then was a safe bet that the crane chains would break before the pattern would shift.

"After some delay in the machine shop the flasks, plates and arbors were delivered to the foundry and a gang of helpers chaperoned by a duly qualified molder were turned loose and told to eat it up. There are no difficult or complex factors to contend with in ramming ingot molds and a gang of six men were able to turn out six molds a day in a short time. The molds were good looking both inside and out and when placed in use in the open hearth they stripped clean.

"Lots of foundry difficulties start after all troubles seem to be over. This job was swinging along smoothly in the foundry when complaints began to arrive from the open hearth that the new molds were not giving service. Their maximum life seemed to be about 50 heats while some of them cracked and had to be discarded after only being in use a few times. The foreign molds had an average life of over 100 heats Some of them ran up to 150 heats. The trouble was traced to the metal used, according to the opinion of those concerned.

"One of the company's blast furnaces ran on foundry iron but owing to the nature of the ore and coke in that particular part of the world, the resultant pig iron carried exceedingly high percentages of sulphur and phosphorus. A sulphur content of from 0.10 to 0.20 per cent and phosphorus from 1 to 1.25 rendered it altogether out of the question for ingot molds. Instead of pig iron, old broken ingot molds were charged in the cupola together with sufficient ferrosilicon and ferromanganese to bring the iron up to the analysis of one of the foreign molds which had been analyzed for that purpose. Analyses and tests were taken every day and the iron kept as near as possible to a fixed standard; but the molds continued to break.

"The job finally was abandoned after a couple of years and then under a change of management was resurrected again. One of the men who had taken an active part in designing the rigging for the early experiments was still in the employment of the company but in a more important position. He had done considerable thinking over the ingot problem and when he had the opportunity the second time, he decided to try out a theory which he had developed. He had the design of the mold changed making the corners thicker and the sides thinner and he got a set of molds that had the foreign molds hacked right off the map when it came to showing records of heats poured."

"All right," I said, "if you now will kindly make a motion to adjourn I will second the same with great pleasure. I have a record down around our way of having never missed an evening meal and I don't wish to lose it, and besides it might arouse suspicions."

Metallurgical Theories Conflict

(*Concluded from page 468*)

varying from 0.05 to 0.5 per cent on the mechanical properties of malleable cast iron. The addition of phosphorus does not improve the mechanical properties of malleable while above 0.20 per cent the properties are impaired.

TOUCEDA, E. Permissible Phosphorus Limits in Malleable Iron Castings. American Foundrymen's association transactions, 24, p. 209, 1916. Finds phosphorus up to 0.325 per cent content has no effect on the grain size of malleable. The evil effects of phosphorus are slow to make themselves felt if the combined carbon is low.

Some changes have been made on the joint committee: The United States shipping board has been succeeded by the Society of Naval Architects and Marine Engineers, represented by F. W. Wood, vice president, International Shipbuilding Corp., Philadelphia.

The place on the joint committee left vacant by the discontinuance of the United States railroad administration has been taken by the American Railroad association, mechanical section. H. B. MacFarland, Atchison, Topeka & Santa Fe Railroad Co., Chicago, and F. M. Waring, Pennsylvania railroad, Altoona, Pa., have been appointed to represent the railroad association.

This report of the joint committee is the second one issued. The first report was noted in THE FOUNDRY of April 15.

Munition Plant Converted to Peaceful Use

An interesting aftermath of the war noted by the American Chamber of Commerce in London is the proposal by the Irish Farmers union comprising 50,000 members, and a number of other Irish co-operative societies to produce agricultural implements of all kinds in Ireland. It is understood that an option has been secured on Kynoch's munition works at Arklow, County Wicklow, with this object in view. Negotiations are practically concluded for raising $1,250,000 to finance the project.

The Kynoch munition plant covers 3000 acres on which there are 400 buildings, including workmen's dwellings, social clubs, canteens, etc.

It is the intention of those interested in the undertaking to start work on agricultural castings, develop into agricultural machinery and ultimately turn out everything a farmer requires. Electric and steam power are said to be available to the extent of 6000 horse power and the different units of the works are linked together by 37 miles of railroad. An elevated railroad connects the plant with private wharves where several large electric cranes are already in existence.

Correcting Flaws in Metals and Mixes

Problems of the Gray-iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Car Wheel Scrap Softened by Ferrosilicon

Question—What per cent of silvery pig iron should I use with car-wheel scrap to obtain an iron easy to machine?

Answer—The amount of silvery pig iron to use will of course depend upon the percentage of silicon in the silvery iron. This has a wide range of composition. You should have a resulting iron with from 1.75 to 2.20 per cent silicon, depending upon the thickness of the section of your castings. When using an 8 per cent ferrosilicon you would need to have 25 per cent of the mixture ferrosilicon, if you use nothing with it but car-wheel scrap. This could be figured in the following manner, which will illustrate the method of calculating to be used for ferrosilicon with any amount of silicon and to obtain any amount of silicon in the cast iron.

	Weight		Per cent silicon	
Ferrosilicon	250	×	8.0	2000
Car wheel	750	×	0.6	450
	1000			2450
Per cent silicon....................				2.450
Loss in melting.....................				25
Resulting silicon—per cent...........				2.20

In this connection we would call to your attention that it is difficult to mix in the cupola two irons which vary so widely in their silicon contents. For this reason care should be taken to allow at least one charge of metal to be melted in the bottom of the cupola before tapping each time.

Mixture for Hard Iron

Question.—We want to make hard, white-iron pipe castings for use in conveying ashes and cinders from the boiler room to the ash pit. Will you kindly tell us what kind of iron to use? Would steel in the mixture be of any benefit?

Answer.—Castings such as you mention should run low enough in silicon and high enough in sulphur to cause all of the carbon to stay in the combined form. Free carbon will produce gray or mottled iron and if you find this condition you will know that you must use a lower silicon iron. If you use chills in the molds it will not be necessary to run the silicon so low.

Without using chills we would recommend that you purchase an off-iron with 1 to 1.50 per cent silicon and high sulphur, say around 0.07 or 0.08 per cent. It would not be advisable to use any scrap except what you make yourself unless you can conveniently secure some low-silicon scrap of fairly uniform composition. We would not recommend the use of steel in your mixture as the steel increases the shrinkage and would give more trouble in this hard iron which is already high in shrinkage, without benefiting the iron for your purpose. It must also be borne in mind that white iron castings are easily broken, and for that reason discretion must be used in preparing the mixture so that it will have the necessary strength as well as hardness.

Cylinders for Refrigerating Machines

Question—Occasionally we have calls for cylinder castings to be used on refrigerating machines for pumping ammonia. We would be pleased to receive some information regarding the kind of iron best suited for this purpose.

Answer—Cylinder castings for use in refrigerating machines require a close grained iron. This can be secured by a mixture of 30 to 40 per cent gray-iron scrap; 10 to 15 per cent steel scrap and the remainder pig iron. The stock should be of such a composition that you secure a low phosphorus metal, ranging from 0.20 to 0.30 per cent phosphorus. The silicon content should be between 1.50 and 2.20 per cent depending upon the thickness of the section of the cylinder, the lower silicon being used with cylinders of the thicker sections. The proper amount of silicon may be gaged by the amount of combined carbon found in the metal. This should not be lower than 0.50 or higher than 1 per cent. Sulphur should be kept below 0.10 per cent if possible, and manganese may range from 0.50 to 0.80 per cent.

While the composition of the iron is important, a good iron cannot be secured unless proper melting methods are employed. Care should be taken to see that the iron is hot. The cupola should be well fluxed, and enough coke should be added to the bed and between the charges to prevent oxidization.

Castings Made from Crucible Steel

Question—We wish to use our crucible furnace equipment occasionally to make small steel castings, using boiler punchings as melting stock. Will you please advise us what alloys we should add to obtain a soft steel?

Answer—When using boiler punching stock for making soft steel for castings, in the crucible, it is necessary to add sufficient silicon to bring the silicon in the metal up to between 0.20 and 0.30 per cent. This would probably best be added in the form of 50 per cent ferrosilicon. The manganese in the finished steel should run between 0.45 and 0.55 per cent. In order to secure this percentage of manganese it may be necessary to add a small amount of that metal in the form of 80 per cent ferromanganese. The carbon in soft steel castings should range between 0.20 and 0.30 per cent. The punchings as melted down would probably contain this amount of carbon. Should it be necessary to increase the carbon content, some coke dust, retort carbon or petroleum coke should be placed in the bottom of the crucible before the charge is put into the crucible. This is desirable because a low carbon steel would be difficult to melt and the increase of carbon would raise the melting point.

A Substitute For Malleable Iron

Question.—What metal will come the nearest to giving the same service as malleable iron?

Answer.—No metal will give identically the same service as malleable iron for castings. If strength is required, soft steel, with carbon between 0.20 and 0.30 per cent, would be a good metal to substitute. Some foundries substitute a brass which is somewhat lower than malleable iron in tensile strength, when strength is not required and the castings are desired in a hurry. A brass composed of copper, 84.0; tin, 12.0; zinc, 3.5, and lead, 0.5 per cent, would have a tensile strength of 28,000 pounds per square inch. In melting this brass 2 per cent of phosphor-tin is sometimes substituted for the pure tin.

Twister Wrecks Foundry

What a tornado can do to a foundry is shown in the accompanying illustrations, from photographs taken for the Charles C. Kawin Co., foundry engineers, Chicago, after the storm that hit St. Johns, Mich., Sunday, March 28. They show the wreck of the Industrial Foundry Co.'s plant, owned principally by John Spousta.

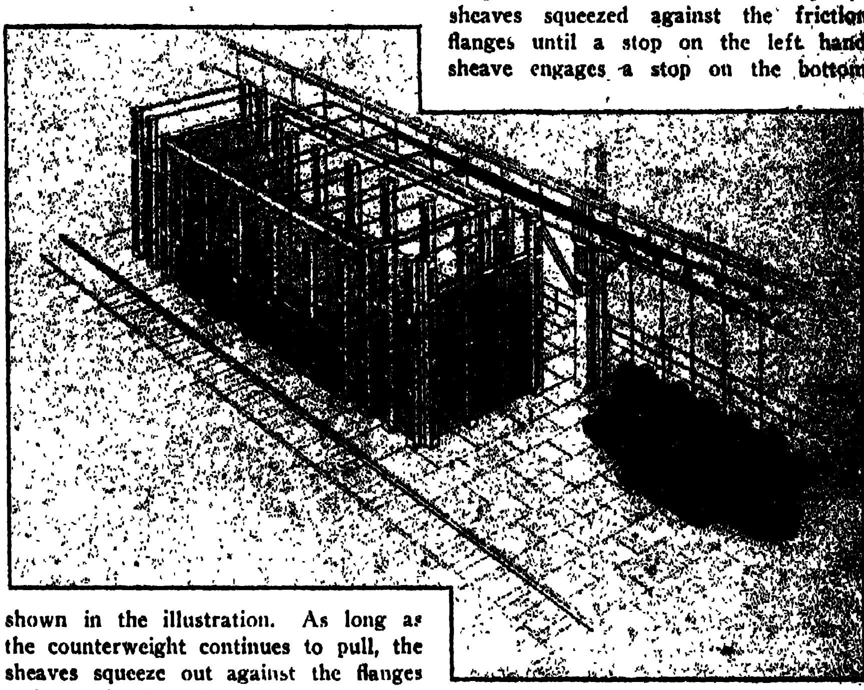
When the storm had passed, leaving the older portion of the foundry flat and the newer portion unroofed the Kawin service was appealed to by wire and a representative was on the job Monday morning. Plans for rebuilding were back in St. Johns Wednesday in readiness to begin work.

However, Mr. Spousta had been figuring on removing to Howell or Hillsdale, Mich., and decided not to rebuild until he comes to a conclusion as to his location. Instead, the foundry has been roofed and operations resumed on a lessened scale. An interesting development was the earnestness with which all the employes turned to the task of clearing wreckage and replacing the roof, as the only means for resuming their labors. Only one man of the entire force demurred at doing this work and the remainder used every effort to restore order.

An Automatic Control for Furnace Door Hoist

A positive automatic device which prevents heavy furnace doors such as those used on open hearth and heating furnaces from being lifted or lowered too far, has been developed by the Link-Belt Co., Chicago. The device forms an integral part of a hoist which is made in several sizes adapted to varying loads. On each hoist is mounted a pair of chain sheaves attached to a worm wheel shaft between two flanges which are pinned to the shaft and supplied with fiber friction surfaces on the sides toward the sheaves. The worm wheel is driven by a worm mounted on the shaft of a reversible motor, the worm and wheel being inclosed in a suitable housing.

To raise the furnace door the motor is started in the direction which will pull down on the left hand chain as



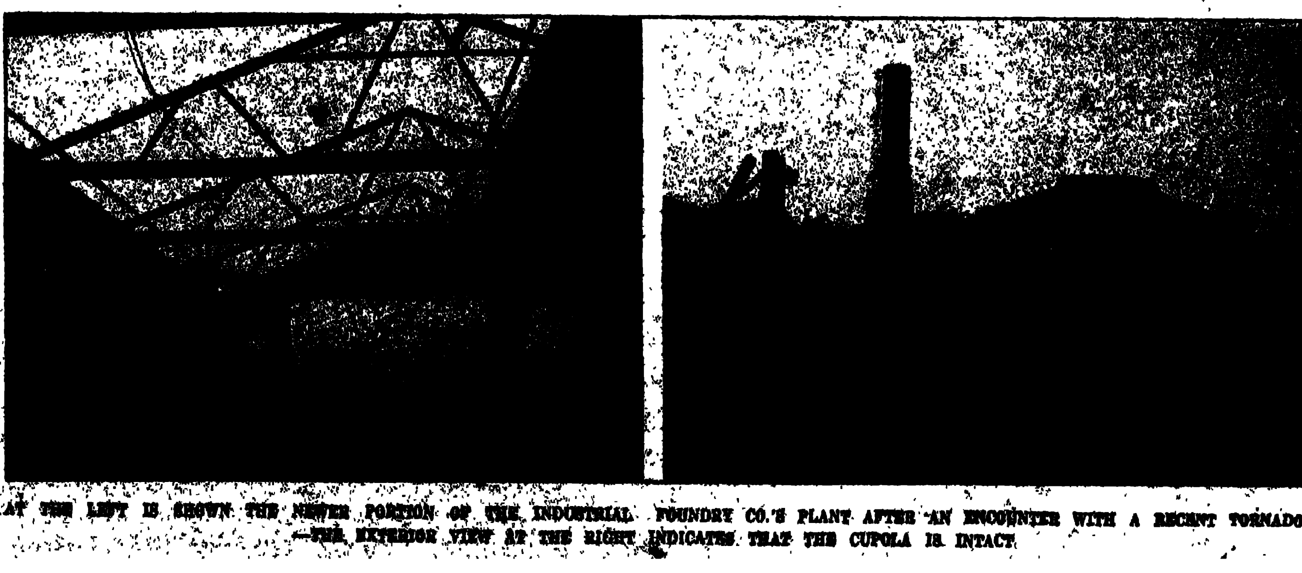
DIAGRAMMATIC VIEW OF HOIST IN POSITION

shown in the illustration. As long as the counterweight continues to pull, the sheaves squeeze out against the flanges and are thereby driven in the direction which will wind up the left hand chain and thus lift the door.

The right hand sheave has a fixed stop on its periphery so located that it will come in contact with a stop on the bottom casting when the furnace door has reached its proper height. With the motion of the right hand sheave arrested by this stop, the shaft cannot rotate the left hand sheave because the forced contact between the sheaves and the friction flanges is relieved. Over winding is impossible and if through carelessness the current is not shut off promptly the shaft with its flanges simply will continue to revolve but without the power to grip and rotate the sheaves.

For lowering the doors the direction of the motor is reversed and practically the same process repeated except that in this case the motor lifts the counterweight, while the pull from the weight of the door serves to keep the sheaves squeezed against the friction flanges until a stop on the left hand sheave engages a stop on the bottom casting and prevents over winding of the counter weight chain in the manner already described. The motor is started, stopped or reversed by the ordinary push button mechanism.

The Electric Furnace Construction Co., Philadelphia, has appointed H. M. Smith as its agent in Cleveland. Other agencies established by this company include San Francisco with A. S. Lindstrom in charge; Birmingham with McCrum & Gillem, agents; and St. Louis where the General Welding & Supply Co. has been chosen.



AT THE LEFT IS SHOWN THE NEWER PORTION OF THE INDUSTRIAL FOUNDRY CO.'S PLANT AFTER AN ENCOUNTER WITH A RECENT TORNADO—THE EXTERIOR VIEW AT THE RIGHT INDICATES THAT THE CUPOLA IS INTACT

THE FOUNDRY

A semimonthly journal devoted to all branches of the foundry trade

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Contents

Theories Accepted too Readily

THE world is quite inclined to take things too much on hearsay or to believe the first plausible theory which presents itself to account for established phenomena. This is true of the foundry industry as well as of the world at large. Possibly one consideration which inclines to this mode of reaching conclusions is that great expense often is involved in testing or disproving beyond question a theory advanced. For years steel manufacturers and users have accepted without reservation the statement that sulphur and phosphorus are injurious to steel, and have made the limits for these elements as low as possible in their various steel specifications. Basic open-hearth steel is held to the lowest possible limits, while acid open-hearth steel is allowed a slightly higher percentage of both phosphorus and sulphur. Bessemer steel may have approximately twice as much sulphur and phosphorus as basic open-hearth steel. The variations in the allowable limits in steel made by the different processes perhaps may be accounted for by the nature of the process. In the basic open-hearth, the phosphorus of the original charge may be greatly reduced and the sulphur content may also be somewhat lowered, but in the acid process the percentages of both of these elements is slightly increased. Again in the bessemer process the sulphur is considerably augmented when the charge is melted in the cupola, and the percentage of phosphorus is raised. Now after all these years during which the pronouncement of some metallurgists and steel users was accepted, the theory as to the effect of sulphur and phosphorus on steel is seriously questioned and investigations have been started to determine definitely the limits above which these elements are injurious to steel. Some light also is sought as to whether there are not some qualifications which make sulphur and phosphorus either injurious or harmless.

In the iron foundry, phosphorus is not considered injurious to all grades of metal and in some cases it is held to be decidedly beneficial. Even in the most extreme cases, it never is kept as low as the maximum limits insisted upon for phosphorus in basic open-hearth steel. Sulphur is accorded a different reception in most iron foundries where it is regarded as detrimental in any amount above the quantity determined by the lowest amount which commercially can be secured. However, a few foundries do not so regard it. Some car-wheel foundries in particular pour iron with as much as 0.220 per cent sulphur and maintain that this amount is advantageous to the metal. Again, in white-heart malleable the sulphur at times amounts to over 0.50 per cent without any apparent injury to the iron.

Possibly the conclusions regarding the deleterious effects of sulphur on cast iron have been too hastily accepted. The largest part of the sulphur content in iron comes from the coke used and it may be that there is some other quality in high-sulphur coke which makes the iron sluggish and causes gas holes in the castings. The fact that the increase in sulphur is easily determined may have been the basis for the charge that it is detrimental to the iron. This is partly substantiated by the statement of one metallurgist who has noticed that iron is differently affected by sulphur which is taken up in the cupola, than by sulphur which forms one of the component parts of the iron as it leaves the blast furnace.

Trade Outlook in the Foundry Industry

BRIGHTER prospects are evident in the industry in general, due to the slowly clearing railway situation, which through stagnation at terminals has threatened operations in every foundry of the country. Coke, pig iron, coal, sand and scrap consequently are moving more freely than they did two weeks ago, and production is increasing. The car shortage which has been a factor of great concern for some time, continues to be little improved.

Optimism Prevalent

General business conditions as they react directly upon the castings demand, show few evidences that would warrant extreme pessimism. Credit is tight. Price reduction agitation has led to a falling off in the public's demand for wearing apparel, and building trades have been strongly affected due to the general cessation of construction operations. However, the entire iron and steel business is established upon a much more stable foundation. Exorbitant charges, common in many merchandising lines, have been almost entirely absent in the various branches of the metal industry and therefore there is less pressure tending to reduce prices. Further, the greater portion of all iron and steel products has gone to make up standard and essential articles of commerce, necessities of an established character. That the automobile business has absorbed a great part of the output of central western steel plants and foundries, and that passenger cars commonly are deemed nonessentials, does not alter the situation. Passenger car manufacturers deny the luxury classification ascribed to their product, stating that a large percentage of the automobiles purchased as passenger cars are for business purposes. Regardless of the merits of this contention, the fact remains that the demand for this class of cars remains stable, and although some cancellations are reported, the advance orders were in such volume that the entire scheduled production probably will be needed to meet the requirements. It is stated that the shortage of raw materials and credit difficulties may force a reduction of about 35 per cent in the 1920 estimated output of passenger cars, but this will little more than allow capacity for needed castings.

Requirements Above Normal

Gray iron shops, except where hampered by continued transportation difficulties, are busy and have orders on their books which extend through the next six months. A few exceptions are noted where manufacturing establishments have asked deferred deliveries pending the receipt of other needed materials. Automobile castings makers, in general, have had only a few cancellations and the demand continues briskly. Local difficulties have led a number of eastern automobile makers to inquire among western foundries for castings to meet their needs. In the south, a steady increase in sugar machinery requirements is noted, and in Birmingham, Cuban interests maintain staffs of buyers and inspectors to expedite shipments of sugar mill equipment. Malleable plants are working steadily, sustained by a steady current of orders. Implement manufacturers, the automotive industry and the electrical trades are furnishing the bulk of demand. Railway car manufacturers are not yet calling for any great tonnage of castings, from general jobbing shops, but those foundries directly connected with the car building industry are again in operation, and car wheel foundries which during the past few years have operated mainly upon replacement work, again are approaching full operation.

Iron Output Improves

The lessening grip of the railway strike is reflected in the improvement of pig iron production during the month of May. According to reports secured by *The Iron Trade Review*, the total tonnage for May was 2,991,825 as compared with 2,752,670 tons as reported for April. This represents a net gain of 239,155 tons. The average daily production was increased by 4756 tons, to 96,510 tons per day. A greater gain was registered by steel works than by merchant furnaces. The total of merchant iron produced is shown to be 808,751 tons in May as compared to 761,331 tons for April. This is an average of 26,088 tons per day for May and 25,337 tons per day for April, a gain of 751 tons daily. Demand for last half iron is almost neglible at present. Producers state that a great amount of first half iron is going forward into the last half for delivery. Coke for immediate delivery is in strong demand and premium prices have been paid by foundrymen unable to secure fuel which they have contracted at lower prices. It is felt that the present price level for coke is a peak and that a recession is due, particularly since transportation improves daily in the producing regions. Coke deliveries have improved greatly, but have as yet failed to catch up with the consumption. St. Louis foundries report an unsatisfactory prospect, as fuel is not being delivered in quantity, future orders are taken subject to a sort of rationing system which permits the producer to cancel rather than defer shipping in event of inability to delivery at the stated time. This confusing feature adds to an already complicated situation.

Nonferrous foundries are operating normally, with a fair volume of new business. Prices for nonferrous metals, based on New York follow: Copper, 18.12½c to 18.25c; lead, 8.87½c to 9.00c; tin, 47.75c to 48.00c; antimony, 8.62½c to 8.87½c; aluminum, No. 12 alloy, producers' price, 32c and open market, 31c. Zinc is quoted at 7.62½c to 7.70c, St. Louis.

Prices of Raw Materials for Foundry Use

CORRECTED TO JUNE 7

Iron	
No. 2 Foundry, Valley	$44.00
No. 2 Southern, Birmingham	42.00 to 44.00
No. 2 Foundry, Chicago	43.00 to 45.00
No. 2 Foundry, Philadelphia	45.60 to 48.10
Basic, Valley	43.50
Malleable, Chicago	48.50
Malleable, Buffalo	46.25

Coke	
Connellsville foundry coke	13.00 to 15.00
Wise county foundry coke	12.00 to 12.50

Scrap	
Heavy melting steel, Valley	$24.75 to 25.00
Heavy melting steel, Pittsburgh	25.50 to 26.00
Heavy melting steel, Chicago	22.00 to 22.50
Stove plate, Chicago	32.00 to 32.50
No. 1 Cast, Chicago	42.50 to 43.00
No. 1 cast, Philadelphia	37.00 to 39.00
No. 1 cast, Birmingham	30.00 to 33.00
Car wheels, iron, Pittsburgh	41.00 to 42.00
Car wheels, iron, Chicago	36.50 to 37.00
Railroad malleable, Chicago	28.75 to 29.25
Agricultural malleable, Chicago	28.50 to 29.00

Comings and Goings of Foundrymen

CARL G. BARTH, a pioneer in machinery building industry and to whom many other industries owe modern principles of production and management, has been elected an honorary member of the Taylor society. Only two other men have been thus honored by the society, which is the national organization for the promotion of science in management, these being Frederick W. Taylor himself and Henri Le Chatelier, the prominent engineer who developed scientific management in France. Mr. Barth, after engineering studies in his native land, Norway, came to this country in 1881 and was employed as a draftsman by William Sellers & Co., where he remained for 14 years, with the exception of one year. From 1895 to 1899 he was engaged in designing and engineering work in St. Louis; in technical mathematics and manual training and in preparing engineering text books. Then he became associated with Mr. Taylor at Bethlehem with whom he worked on the historic foundations of scientific management. Under Mr. Taylor's guidance he conducted experimental work in the plants of the Link-Belt Co. and the Tabor Mfg. Co., Philadelphia.

P. M. Sullivan has been made foundry foreman for the Railway & Mining Supply Co., Kincaid, Ill.

W. L. Chatfield has been named superintendent of the new plant of the Central Foundry & Supply Co., Nitro, W. Va.

Rev. M. J. Prestidge has been elected president of the Dundee Foundry Co., a newly organized company which is operating an aluminum and brass foundry at Dundee, Mich.

W. T. Myer has been appointed by D. Gleisen, manager, to be directing transmission engineer of the industrial bearings division for the Hyatt Roller Bearings Co., New York.

William H. Kochenderfer, formerly with the Southwark Foundry Co., Philadelphia, has been made general manager of the Chambersburg Foundry & Machine Co., Chambersburg, Pa.

Charles A. Herrmann, formerly chief chemist for the Edward B. Lemon laboratories, Milwaukee, has been appointed to the bureau of chemistry, United States government laboratory, New York.

Carl G. Broehm, formerly foundry superintendent of the Michigan Lubricator Co., Detroit, manufacturer of brass goods, now is secretary of the LeRoy Broehm Foundry Co., 932 Jefferson avenue east, that city.

O. E. Paris has resigned his position as foundry foreman for the Mann Corp., Kankakee, Ill., to become foundry superintendent for the River View Foundry Co., a new plant which has been established at Aurora, Ill.

Carl Aichberger has resigned as secretary and sales manager of the Sandusky Foundry & Machine Co., Sandusky, O., and is now connected with the Fitzpatrick Products Corp., 99 John street, New York, in an executive capacity.

Charles D. Meikenhaus, who for the past three years has been assistant superintendent of the Whiteley Malleable Castings Co., Muncie, Ind., recently has been made superintendent of the Denver Rock Drill Mfg. Co.'s foundry at Denver, Colo.

Livingston Middleditch Jr. has joined the heroult electric furnace department of the United States Steel Corp. as a salesman. Mr. Middleditch originally served at the Gary and South works of the United States Steel Corp., and recently has been connected with the Consolidated Steel Corp.

M. Samuels & Co., Ltd., 25-27 Bishops Gate, London, England, have been appointed general representatives in England of the Foundry Equipment Export Corp. Alba B. Johnson Jr., manager of this corporation, now is in England and he is making his headquarters with the Samuels company.

Glenn L. Orr recently has been elected secretary and treasurer, and has been made general manager for the Lansing Foundry Co., Lansing, Mich. Mr. Orr is well known in Detroit automobile circles through his previous connections with the Detroit Engine Works, Hupp Motor Corp., Packard Motor Car Co., and Briscoe Motor Corp., Jackson, Mich.

J. Do Drugan recently has accepted a position as metal pattern maker for the Buick Motor Co., Flint, Mich. Mr. Drugan's experience covers over 13 years, during which time he has worked on the production of metal patterns for the United Shoe Machinery Corp., Beverly, Mass., Framingham Foundries, and the Wright Martin Co., New Brunswick, N. J.

Eugene Schoen, general manager of the International Oxygen Co., Newark, N. J., has sailed for Europe to make an inspection of the company's branches in London and Paris and to extend the scope of operations in France, England, Belgium, Germany, Switzerland, Sweden and Denmark, where an increasing demand for oxygen and hydrogen generating apparatus is reported.

Henry Berlinger, who has had a wide experience in the nonferrous metals trade, has become affiliated with the Sandusky Foundry & Machine Co., Sandusky, O. Mr. Berlinger formerly was eastern sales representative for the Michigan Smelting & Refining Co., Detroit. He will develop business in new lines for that company's fluid compressed bronze castings and in the purchase of nonferrous metals.

Victor T. Noonan, formerly affiliated with the Bethlehem Shipbuilding Corp., has become affiliated with the Smith Insurance Service, Inc., 185 Devonshire street, Boston, in the capacity of consulting accident prevention engineer. Mr. Noonan formerly was safety director of the industrial commission of Ohio and as chairman of the committee on accident prevention of the American Foundrymen's association was instrumental in compiling the safety code adopted by that organization.

George E. Long, who recently was re-elected to the board of directors of the Joseph Dixon Crucible Co., Jersey City, N. J., at the annual election and who has been actively connected with that company for 43 years, has announced his decision to retire from the senior vice presidency. Mr. Long entered the service of the company as stenographer and was advanced through the office of the secretary, treasurer and vice president to the position which he held at the time of his retirement.

Engineers Study Casting Production Problems

The most important session of the spring meeting of the American Society of Mechanical Engineers was given over to a symposium on castings, comprising six papers covering malleable, die, aluminum, steel, gray iron and brass castings. This meeting, held Wednesday morning, May 27, was presided over by Frank O. Wells, president, Greenfield Tap & Die Corp., Greenfield, Mass.

Richard Moldenke, Watchung, N. J., opened the discussion with a paper on gray iron castings, in which he emphasized that castings of this material may be produced to meet a wide variety of requirements. He pointed to the use

of high proportions of scrap in the cupola during the war and declared that this practice will be paid for within the next 20 years when the high-sulphur and oxidized iron will return from the scrap piles to be used again. This problem will be met, he said, either by using an increased amount of pig iron or by developing a practical desulphurizing process. Suitable desulphurization can be had by melting in the cupola and transferring the charge to a basic-lined electric furnace.

The shrinkage of steel castings was discussed in connection with a paper by John H. Hall, Taylor & Wharton Steel Co., High Bridge, N. J. Arthur M. Greene, Rensselear Polytechnic institute, Troy, N. Y., read a paper prepared by Prof. Enrique Touceda on malleable castings. Capt. J. L. Hughes, ordnance department, United States army, explained experiments made by the government with malleable bombs, stating that difficulty was found in eliminating porosity. Charles Pack, Doehler Die Casting Co., Brooklyn, N. Y., discussed recent developments in die casting and in the absence of Zay Jeffries, Aluminum Castings Co., Cleveland, presented the latter's paper on aluminum castings. The subject of permanent molds came up for considerable discussion, the opinion seeming to prevail that investigators should search for *long-life* molds instead of *permanent* molds.

Converted to Iron Foundry

The Standard Process Steel Corp., Phillipsburg, N. J., has been reorganized, new equipment has been added and practically the entire plant will be given over to the manufacture of large and small gray iron castings on molding machines. Ralph Sleicher, Troy, N. Y., has been appointed general manager of the foundry. Mr. Sleicher is peculiarly well fitted for this position as he was for a number of years with the West Side Foundry in Troy and largely contributed to its success. The sale of the entire output of the plant has been placed in the hands of J. W. Sanders Co. of 30 Church street, New York city, as agents.

The Sandusky Foundry & Machine Co., Sandusky, O., recently was reorganized when W. H. Millspaugh repurchased holdings he sold three years ago to Irving Brown and other Cleveland men. Mr. Millspaugh was elected president; Judge W. C. Boyle, Cleveland, vice president; Louis A. Stroh, Sandusky, treasurer, and F. S. Whitcomb, Cleveland, secretary.

The Adirondack Steel Foundries, Inc., Watervliet, N. Y., have completed a new steel foundry and will put it in operation about June 15. It is equipped with both open hearth and electric steel furnaces.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

Erection of additions to the plant of the Interstate Foundry Co., Cleveland, is contemplated.

A plant will be established at Ravenna, O., by the National Furnace & Stove Co.

Erection of a foundry and forge shop has been started by the Wright Mfg. Co., Lisbon, O.

Fire recently damaged the foundry of the Gross Mfg. Co., West Hazleton, Pa. It will be rebuilt.

The C. H. Turner Foundry Co., Statesville, N. C., plans the erection of a foundry, 40 x 50 feet.

An addition, 70 x 180 feet, is being planned by the Wilmington Casting Co., Wilmington, O.

Erection of a foundry is contemplated by the Columbian Foundry Co., McKeesport, Pa.

The Kennedy Corp., Baltimore, plans the erection of a foundry.

Bauer Bros., Springfield, O., plans the erection of a foundry building, 200 x 250 feet.

The plant of the Riverside Steel Castings Co., Kearney, N. J., recently was damaged by fire.

Fire recently damaged the plant of the Record Foundry & Machine Co., Moncton, N. B.

The F. Rassmann Mfg. Co., Beaver Dam, Wis., is increasing its foundry capacity.

The Fulton Iron Works, St. Louis, contemplates the erection of an addition to its foundry, 112 x 120 feet.

Fire recently damaged the plant of the Gravois Foundry Co., 5007 South Thirty-eighth street, St. Louis.

Plans are being drawn for the erection of a pattern shop for the Lebanon Steel Co., Lebanon, Pa. The building will be 55 x 110 feet.

Shranger & Johnson, Atlantic, Iowa, have started work on the erection of a foundry building, 110 x 200 feet.

Automobile castings will be produced in an addition to the plant of the Almont Mfg. Co., Almont, Mich., which is now under construction. The addition will be 70 x 80 feet.

W. C. Arnold, M. Elliott and Frank A. Calsen [illegible] were named as the incorporators of the Chambersburg Foundry Co., which was recently chartered with a capital stock of $50,000, at Philadelphia.

The Ruka Foundry & Machine Co., Boscobel, Wis., has leased its plant for six months to the Hunt Mfg. Co.

The capital stock of the Grand Rapids Brass Co., Grand Rapids, Mich., recently was increased from $500,000 to $1,250,000.

The Universal Iron Foundry and John F. Pitts, Inc., 21 Rose street, New York, have been merged with the Pitts & Webber Iron Foundry.

The capital stock of the Piston Ring Castings Co., Cleveland, recently was increased from $25,000 to $100,000.

Ground has been broken by the St. Louis Malleable Castings Co., St. Louis, for the erection of two plant buildings.

A company has been formed at Grand Rapids, Mich., by R. D. Bourds and G. O. Bouchard, to engage in the manufacture of piston rings.

Erection of an addition to its foundry is contemplated by the Worcester Foundry Co., Worcester, Mass.

The capital stock of the West Steel Casting Co., Cleveland, recently was increased from $100,000 to $500,000.

The capital stock of the Superior Die Casting Co., Cleveland, recently was increased from $25,000 to $50,000.

The Marietta Foundry & Machine Co., Marietta, O., has been incorporated with a capital of $25,000, by R. Ross, O. Morgenstern and C. W. Suder.

The Marion Foundry & Machine Co., Marion, Ind., plans the erection of a warehouse and boiler room.

The Mohawk Piston Ring Co., Cleveland, recently was incorporated with a capital of $50,000, by Harry Decklen, P. Grodiner and others.

The Interstate Brass Co., 18 North Dearborn street, Chicago, plans the erection of a storage building.

M. J. Franklin and others recently organized the Calhoun Castings Co., at Battle Creek, Mich.

Work has started on the construction of a foundry building for the Llewellyn Iron Works, Los Angeles.

Erection of a plant addition is contemplated by the Globe Malleable Iron Steel Co., 101 Greenway avenue, Schenectady, N. Y.

Capitalized at $20,000 the Quality Foundry & Mfg. Co., Los Angeles, recently was incorporated by Robert J. Schefferly and others.

Having increased its capital from $25,000 to $100,000, the Liberty Foundry Co., Inc., 1881 Centre Line avenue, Detroit, is building a new foundry.

Plans have been prepared for the erection of a foundry, 40 x 80 feet, for the Dayton Standard Scale Co., Dayton, O.

Plans are being prepared for enlarging the general plant and foundry of the Peerless Mfg. Co., Louisville, Ky. The company plans to add stoves to its present output.

The Colonial Brass & Bronze Co., Boston, recently was incorporated with a capital of $125,000, by Thomas F. Brown, Russell C. Harrington and O. W. Harrington.

The Ohio Foundry Co., Vernon, Cal., recently was chartered with a capital of $20,000, by B. G. Holz, Larne Seibert, 480 North Beadry avenue, Los Angeles, and others.

Capitalized at $20,000, the Economy Sash Weight Co., Los Angeles, recently was incorporated by Edward A. Stephens, A. F. Hannaford, T. C. Burnside, F. G. Mortimer and M. M. Mortimer.

The Holmes Bronze Foundry Co., Cleveland, recently was incorporated with a capital stock of $30,000, by R. F. Holmes, R. E. Fleming, R. H. Peck, J. H. Mills and others.

An increase in the capital stock of the Peninsular Brass Co., Detroit, recently was made, bringing the capitalization of the company to $75,000.

M. J. Prestidge is president of the Dundee Foundry Co., Dundee, Mich., a newly organized company which is operating an aluminum and brass foundry.

The Western Brass Mfg. Co., Los Angeles, recently was chartered with a capital stock of $10,000,

by Nathan Brostoff, David M. Clayman and L. R. Raymond, 115 Sycamore drive, Los Angeles.

Plans have been prepared for the erection of an addition to the plant of the Specialty Foundry & Machine Works, Portland, Oreg. New equipment will be purchased.

The Winner Gas Stove Co., Huntington, W. Va., recently was incorporated with a capital of $50,000, by J. T. Masterson, H. C. Daniels and others to manufacture gas stoves and equipment.

Contracts have been awarded by the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., for the erection of plant additions, including an office building.

The Hinton Foundry & Machine Co., Hinton, W. Va., recently was incorporated with a capital of $5000, by A. D. Daily, V. V. Daly and H. M. Gaff.

Wood and metal patterns will be manufactured by the Universal Pattern & Mfg. Co., Detroit, which was recently incorporated with a capital of $2g,000. Wallace J. Haberman, 343 Dexter boulevard, Detroit, is one of the incorporators.

Capitalized at $100,000, the American Furnace & Foundry Co., Milan, Mich., recently was incorporated to engage in a general foundry business, by F. E. Ross, Ernest L. Watson and Fred E. Fulkerson.

The California Brass Mfg. Co., Los Angeles, recently was incorporated with a capital of $10,000, by Nathan Brostoff, David M. Clayman, 336 West Forty-ninth street, and L. R. Raymond, 115 Sycamore street, Los Angeles.

Special equipment for piston ring work will be required by the Detroit Ring Casting Co., Plymouth, Mich., recently incorporated with a capital of $125,000. It purchased its plant from the National Foundry & Machine Co.

Incorporated in Indiana, the Kokomo Malleable Co., Kokomo, Ind., has a capital stock of $350,000, of which $250,000 is common and $100,000 preferred. Officers are: President, A. G. Seiberling; vice president, Edward Bridges, and secretary and treasurer, Mole Cook.

The Illinois Malleable Iron Co., Chicago, is reported to have completed its plans for the erection of a plant at Louisville, Ky., where it purchased a site of 42 acres some time ago. The plans call for an annealing plant, 113 x 183 feet and a foundry, 147 x 263 feet.

Contracts have been awarded by the Bernert Mfg. Co., 489 Twelfth street, Milwaukee, for the erection of a foundry and machine shop, 130 x 200 feet, which will be equipped to manufacture pneumatic grain handling machinery. George Bernert is general manager.

A large brass foundry is being erected at Waukesha, Wis., by the Waukesha Brass Foundry Co., that city. The building will be 50 x 265 feet, and will be equipped with furnaces equipped with the most modern electric auxiliaries. C. C. Smith is president and general manager of the company.

Construction of a 2-story vault and pattern shop recently was completed for Gray & Dudley Co., Nashville, Tenn. The building is of modern fireproof construction, 40 x 80 feet. In addition to this improvement, the company has under construction a building, 130 x 208 feet, which will be utilized as an addition to the foundry.

Contracts have been let by the Skagit Steel & Iron Works, Sedro-Wooley, Wash., for the erection of a pattern loft, 60 x 120 feet, four stories, and work is now progressing on the construction of an addition to the plant's pattern shop. In addition to these improvements, the company is installing a 2-ton Greene electric furnace.

Recently organized with a capital of $100,000, the LeRoy-Broehm Foundry Co., 932 Jefferson avenue, Detroit, expects to be ready to engage in active business shortly. It has 10,400 square feet of floor space which will be devoted to the production of brass castings. W. W. LeRoy is president, F. R. LeRoy, vice president, and C. G. Broehm, secretary.

The Unit Stove & Furnace Co., Belleville, Ill., soon will be ready to start operation of its plant at Birmingham, Ala., where stoves, ranges, heaters and hot air furnaces will be produced. Edward Leopold is president of the company. The company purchased the old plant of the Birmingham Gas Mfg. Co. and has transformed it to a stove foundry.

The plant of the Grand Rapids Foundry Co., Grand Rapids, Mich., which recently was taken over by the Oliver Machinery Co., is being remodeled. The new owner plans to install an electric crane of 10 tons capacity, 38-foot span and 250-foot crane runway. The crane has been purchased but the company is still in the market for the crane runway and accessories. A number of molding machines principally of the heavier type, will be purchased and installed. The location of the cupolas will be changed and two new cupolas, which as yet have not been purchased, will be added. In addition to these improvements, the cleaning room will be modernized and some sand-blast equipment provided.

To meet the plans for enlargement of its production, the Maynard Electric Steel Casting Co., Milwaukee, has decided to increase its capital from $125,000 to $250,000. The company, which was established a number of years ago as the Maynard Steel Casting Co., is gradually changing its equipment to electric furnaces. In the latter part of 1918 it erected a new foundry building, 150 x 250 feet, which is equipped with a 1-ton Rennerfelt furnace and a 3-ton furnace manufactured by W. E. Moore & Co., Pittsburgh, which have a daily production of 25 tons. An addition to the plant, 30 x 200 feet, is now under construction, and an extension to the shipping department, 50 x 75 feet, is planned. Sylvester J. Wabiszewski is president of the company.

New Trade Publications

STEAM REGULATION.—The Hagan Corp., Pittsburgh, has published a folder containing various data pertaining to the loss of fuel energy due to poor boiler regulation.

METALLOGRAPHIC APPARATUS Arthur H. Thomas Co., Philadelphia, has published a catalog in which metallurgical microscopes, metallographic cameras, etc., are described and illustrated. Specifications for the various apparatus are given.

INDUSTRIAL TRUCKS. The Stuebing Truck Co., Cincinnati, has prepared a cardboard folder, in which various data pertaining to the efficient operation of industrial trucks are given. A description of the trucks is given.

SANDBLAST.—A condensed catalog written in Italian has been published by the Pangborn Corp., Hagerstown, Md., for distribution abroad. The various types of sandblast and allied equipment manufactured by the company are described and illustrated.

FURNACE ECONOMIZER.—The Electric Furnace Construction Co., Philadelphia, is circulating a 4 page leaflet in which the use of an electric furnace economizer, which it has designed, is described.

TRUCK PLATFORMS.—Steel platforms for industrial trucks are described and illustrated in a folder prepared by the Ohio Equipment Co., Cleveland. The platforms are manufactured by the Youngstown Pressed Steel Co., Youngstown, O.

METAL HOSE.—The Pennsylvania Flexible Metallic Tubing Co., Philadelphia, is circulating a folder in which metal hose for conveying oils, gasoline, paraffin, etc., is described and illustrated.

FORCE FEED LUBRICATORS.—A booklet has been issued by the Hills-McCanna Co., Chicago, in which force feed lubricators, high pressure gage cocks, boiler compound feeders and boiler test pumps are described and illustrated.

BELTING.—The Graton & Knight Mfg. Co., Worcester, Mass., has published a 38 page booklet in which various data pertaining to leather belting are given. This includes, history and advantages of standardization as regards leather belting. The booklet also contains tables of belting standards for various industries, mechanical rules. regarding belting, etc.

GAS GENERATING EQUIPMENT.—The Electrolabs Co., Pittsburgh, has published a booklet in which equipment for generating oxygen and hydrogen gases by decomposing water through passing an electric current, is described and illustrated. The booklet has a number of interesting illustrations, showing large installations as well as a diagramatic layout of a plant.

DECK TABLES.—A bulletin describing and illustrating diagonal deck tables is being circulated by the Deister Concentrator Co., Ft. Wayne, Ind. A number of improvements have been made in these tables, all of which are pointed out in the booklet. The improvements include the introduction of running-in-oil head motions, which are described on pages 7 and 9, and cuts show both the old and new style.

GLUE POTS.—Electric glue pots and their use are described in a folder published by the Oliver Machinery Co., Grand Rapids, Mich. These glue heaters operate on dry heat without the use of water, and are arranged to give three degrees of heat, namely, full, medium and low. The current is controlled by a 3-heat rotary snap switch which indicates the temperatures. Other details are given in the catalog.

BRASS FOUNDRIES.—The S. Obermayer Co., Chicago, has issued a special catalog, a booklet of 112 pages, which is devoted exclusively to the requirements of brass and aluminum foundries. This catalog is complete in every detail and for the convenience of the foundryman, is divided into four sections: Melting, molding room, core room, cleaning and finishing room. The company also has catalog No. 49 for distribution, describing materials for iron, steel and brass foundries.

METALLURGICAL FURNACES.—Annealing and heat treating furnaces of the under-fired type are described and illustrated in a booklet prepared by the Fuller Engineering Co., Allentown, Pa. The types described are designed with the combustion chambers separated from the heating chambers but connected by suitable ports to permit the hot gases to enter. Dampers control the quantity of heat, and these with a burner adjustment, permit regulation of temperature. The furnaces are described in detail and the illustrations include line drawings.

CENTRIFUGAL PUMPS.—Centrifugal pumps of the the single-stage and multi-stage types for various service, are described and illustrated in a booklet recently issued by the De Laval Steam Turbine Co., Trenton, N. J. The booklet contains complete details, and explains fully the use of pump characteristic curves in adapting pumps to various services, the adaption of centrifugal pumps to different types of drives, and information required by the manufacturer in order to design a pump to suit conditions, etc. Formulas and tables are given for calculating horsepower, efficiencies, the readings of meters, friction in pipe lines, etc.

AERIAL RAILWAY.—The Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., has issued a booklet in which electric monorail hoists are described and illustrated. These hoists consist of an electric hoist and cage suspended from trolleys traveling a single I-beam and are operated by electricity. They can be run in either direction at various ranges of speed. In the booklet the plans of two typical installations are shown, with photographs of the machines at work. Each of the several types of hoists manufactured is shown, with detail drawings and in addition specifications of parts are given, while switches, tractage and conductor material are explained and illustrated.

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Adapt Ingot Foundry To Castings

Old Plant Acquired By a New Company is Remodeled—Reverberatory Furnace Has Been Transformed Into a Core Oven—Indirect-Arc Rocking Electric Melting Furnace Is Being Used

BY H. E. DILLER

IF THE average foundry manager or superintendent were to design a foundry for a large tonnage of castings, he would enlist the aid of a staff of specialists to assist him. An architect familiar with foundry design would be essential to plan a building for the conveying machinery and cranes; mechanical engineers would be consulted to secure the most efficient arrangement inside the building, and electrical engineers would be called on to design the power layout. Other experts and specialists would be needed to insure that no mistakes were made which might, in the end result in heavy financial loss. Obviously, such a staff of consultants could be hired only when the problem was of sufficient importance to warrant a large outlay. A more common procedure, particularly when the foundry is of moderate size, entails the application of all the combined experience of those actively in charge of the old plant. The executives take counsel with the superintendent, and draw upon the fund of knowledge which all concerned have accumulated through their own experience or through the medium of technical literature. This knowledge, when used with a liberal admixture of common sense, and an appreciation of the shop's peculiar problems, often results in an unusually efficient plant.

The problem of design is comparatively easy when a new structure is to be erected and every point can be considered in its proper relative importance. However, when the building already is erected and it is necessary to fit the foundry to what already exists, some interesting problems are encountered. Whoever places the equipment should be familiar with the plant's needs and also with all the various apparatus on the market to meet the requirements for otherwise, unsuitable and inefficient equipment may be installed. The Hills-McCanna Co., Chicago, was confronted with the problem of adapting an old

FIG. 1—A BATTERY OF FIVE CRUCIBLE FURNACES IS USED TO MELT METAL FOR CASTINGS—COAL HAS PROVED A GOOD FUEL

building to meet its needs when, toward the end of last year, the foundry building in which the company was operating was found to be too small. An opportunity offered to purchase the foundry of the Denny-Rine Co. on Elston avenue, Chicago. In taking this step, the judgment of three men in the company was relied upon. These men, it might be thought that the cores nearest to the fire would be burned, but by keeping a full bed of coals and an exceedingly slow draft the whole oven is held at a comparatively uniform temperature. The majority of cores are small and may easily be handled on trays by hand.

One of the greatest problems con- cure the entire layout at once, but at first installed overhead tracks from the furnaces to the pouring floor. Ultimately a system as detailed in Fig. 2 will completed.

At present the two lines at the top of the illustration which converge and pass in front of the electric furnace and over the crucible furnaces are the

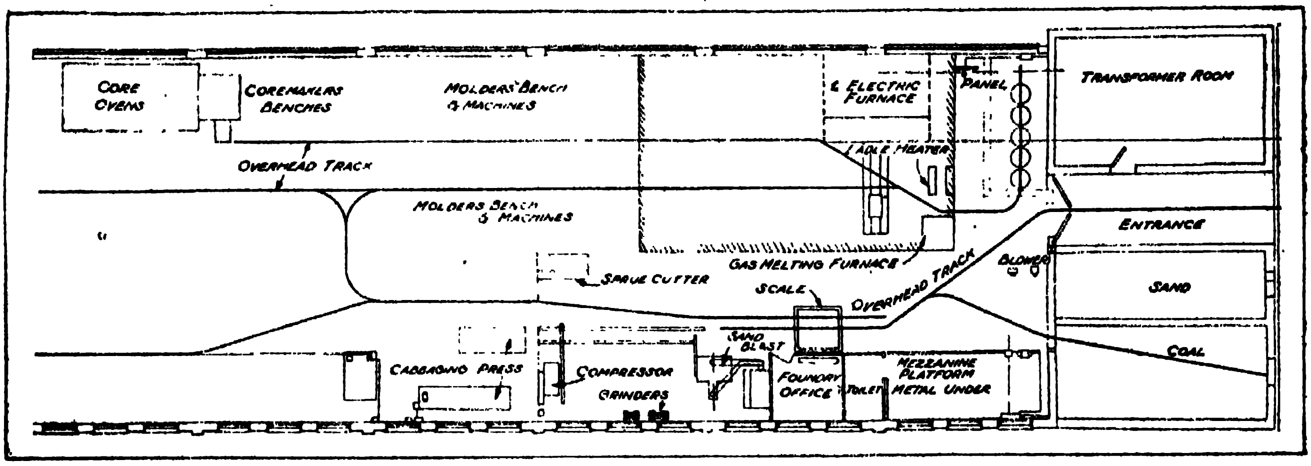


FIG. 2—ONE LINE OF THE CONVEYING SYSTEM EXTENDS OVER THE CRUCIBLE FURNACES, PAST THE ELECTRIC FURNACE, AND BRANCHES INTO TWO LINES ACROSS THE MOLDING DEPARTMENT—THESE ARE CONNECTED WITH ANOTHER BRANCH ON WHICH CASTINGS ARE CARRIED TO THE CLEANING DEPARTMENT

executives of the company, are A. H. Noyes, president; A. H. Smith, secretary and treasurer, and J. W. Dyer, superintendent.

The Denny-Rine plant had been used for making nonferrous ingots and was not equipped with a conveying system or other facilities for making castings. However, it did possess an electric melting furnace and a cabbaging machine, both of which were retained in their original position by the Hills-McCanna Co.

There also was a reverberatory furnace which had been in service at one end of the shop. This was retained, but was converted into a core oven in an interesting manner. The bottom, which sloped to the tap hole at the end opposite to the firing chamber, and which was built to dish in from the sides to the center, was leveled to a point slightly below the tap hole. The first intention was to make the bottom of the improvised core oven at the floor level; but when it was found that the foundation under the bottom lining was solid concrete, the level of the floor of the new core oven was not carried any lower. In addition to leveling and slightly lowering the bottom, the bridge wall was lowered and after racks were placed inside the oven, the reverberatory furnace was completely transformed into a serviceable core oven. The fire box was not changed. Anthracite coal is used for fuel, the location of the firing door being evident from Fig. 8. The racks shown through the open door are quite near the fire and

fronting the new company was the establishment of a transfer system for conveying the metal to the molds and for carrying the castings to the cleaning department and out to the shipping room. It was decided to install overhead trolleys and the system

only ones in service. Material has been ordered for the tracks shown at the bottom of the illustration. Connection will be made with the present system through the switches as shown, so that castings may be loaded on carriers, two of which have been

OPERATION OF
DETROIT ROCKING ELECTRIC BRASS FURNACE

FURNACE NO....... DATE.......

	HEAT NO. 113	HEAT NO. 114	HEAT NO. 115	HEAT NO. 116	HEAT NO. 117	HEAT NO. 118	HEAT NO. 119	HEAT NO. 120
CHARGE	230 Bush 270 Cu Apr 27	230 270 Apr 28	230 270	230 270	230 270	233 276	230 270	
TIME ARC ON	2.30	7.25	9.20	11.00	12.53	2.15	3.27	
METER READING ARC ON								
TIME START ROCK								
METER READING START ROCK								
TIME ARC OFF	3.25	9.00	10.30	12.02	1.50	3.07	4.20	
METER READING ARC OFF								
Kilowatts Used	65	100	95	80	70	63	65	
REMARKS								

FIG. 3—THE DAILY HEAT RECORD GIVES A DETAILED HISTORY OF THE ELECTRIC FURNACE OPERATIONS—NOTE THE POWER CONSUMPTION DROPS FROM 100 KILOWATTS FOR THE FIRST HEAT OF THE DAY TO 63 KILOWATTS FOR A LATER HEAT

manufactured by the Louden Machine Co., Fairfield, Iowa, was chosen. The features of this system which appealed to the company were the prompt delivery on materials required and simplicity which made it possible to erect the units with the company's own workmen. The company did not se-

ordered, and carried to the sprue cutter and cleaning section. Castings are cleaned in a small sandblast barrel supplied by the American Foundry Equipment Co., New York. When castings are taken from the sandblast barrel they are sorted and placed in tote boxes set upon a push truck by

which they are carried to the shipping room. The tote boxes used are the nesting type, manufactured by the New Britain Machine Co., New Britain, Conn. Lugs of pressed steel are formed on the ends of each box, as illustrated at *A-A*, Fig. 10. These lugs rest upon the ends of the box beneath when they are stacked and so allow a nest to be formed, as may be seen on the truck in Fig. 10. The cleaning section also is equipped with a magnetic separator built by the Dings Magnetic Separator Co., Milwaukee.

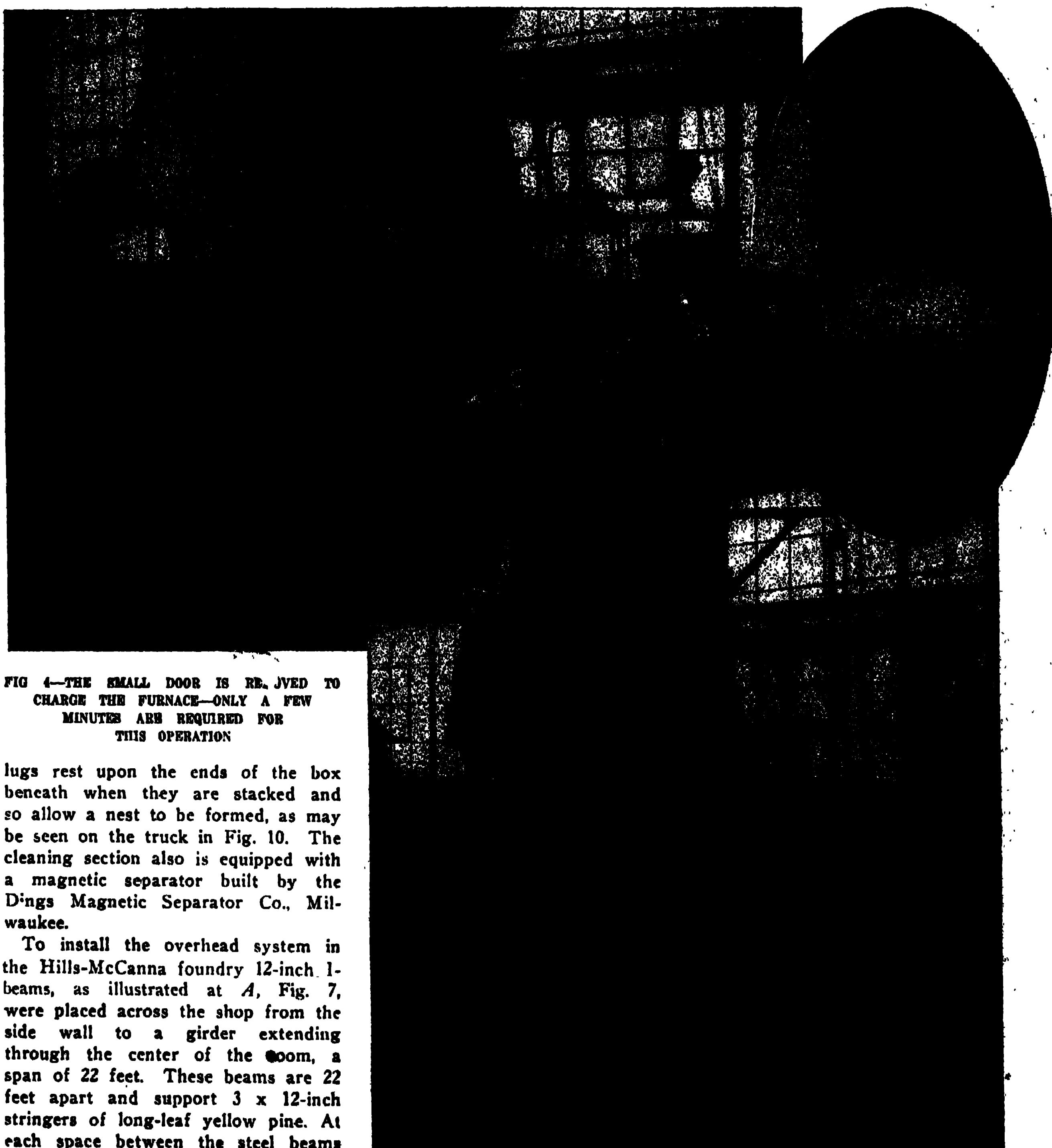


FIG 4—THE SMALL DOOR IS REMOVED TO CHARGE THE FURNACE—ONLY A FEW MINUTES ARE REQUIRED FOR THIS OPERATION

To install the overhead system in the Hills-McCanna foundry 12-inch I-beams, as illustrated at *A*, Fig. 7, were placed across the shop from the side wall to a girder extending through the center of the room, a span of 22 feet. These beams are 22 feet apart and support 3 x 12-inch stringers of long-leaf yellow pine. At each space between the steel beams and the wood stringers a filler block 48 inches long with a cross section 3 x 10 inches is set. The two stringers which end at the point directly under the I-beam are held to the beam by strapbolts which pass over the beam and down each side, through the filler block and one end of each of the two stringers, being fastened to the stringers with nuts and washers. Near each end of the filler block a bolt supplements the strap bolt in attaching the stringer to the block. Hangers which carry the steel rail are affixed to the stringer at intervals of 18 inches. This installation will carry loads up to 1000 pounds. The rail, hangers and trolleys were supplied ready for installation.

Chain blocks are attached to trolleys for carrying the molten metal to the molds. A row of molds can be arranged along each side of both overhead lines, and by piling one mold on another a large number of molds may be placed on the floor at one time. Fig. 7 shows a row of molds being poured. Another row sometimes is set back of the workman who is pouring, and these may be reached by the ladle when the latter is swung around. One of two gyratory riddles made by the Great Western Mfg. Co., Leavenworth, Kans., may be seen hanging on the conveyor at the right in Fig. 7.

οὖργος ὢν ὥσπερ θεραπεύσει αὐτὴν καὶ ἀνανεώσει.... ἐνεργήσει γὰρ καὶ ἰσχύσει πάλιν διὰ τὸν ὑπ' αὐτοῦ ὁριζόμενον νόμον. Hippol. de Antichristo, § 49.

At present, most of the molds are made at 10 benches arranged on both sides of the molding floor. Two molding machines of the jolt-squeezer type, manufactured by the U. S. Molding Machine Co., Cleveland, have been installed. These machines are proving valuable for the class of work made by the Hills-McCanna company, and more will be ordered to care for some of the work now being made at tubs.

As has been said, the company became owner of a small electric furnace when control of the foundry was acquired. This furnace, shown in Figs. 4, 5 and 6, is the indirect-arc type, manufactured by the Detroit Electric Furnace Co., Detroit under license from the United States bureau of mines. Its capacity is 500 pounds. At first this furnace was used primarily for ingot metal, which afterward was remelted for the company's own use in castings, or was sold under specifications which were rigidly observed, covering the alloy content. Through experimentation, the company found that it is possible to pour castings directly from the furnace and at present follows this practice in producing red brass and bronze castings. Excellent results are being obtained on worm gear castings made from government bronze melted in the furnace and poured direct by hand ladles.

FIG. 8—A REVERBERATORY FURNACE HAS BEEN TRANSFORMED INTO A CORE OVEN BY LEVELING THE BOTTOM AND LOWERING THE BRIDGE WALL

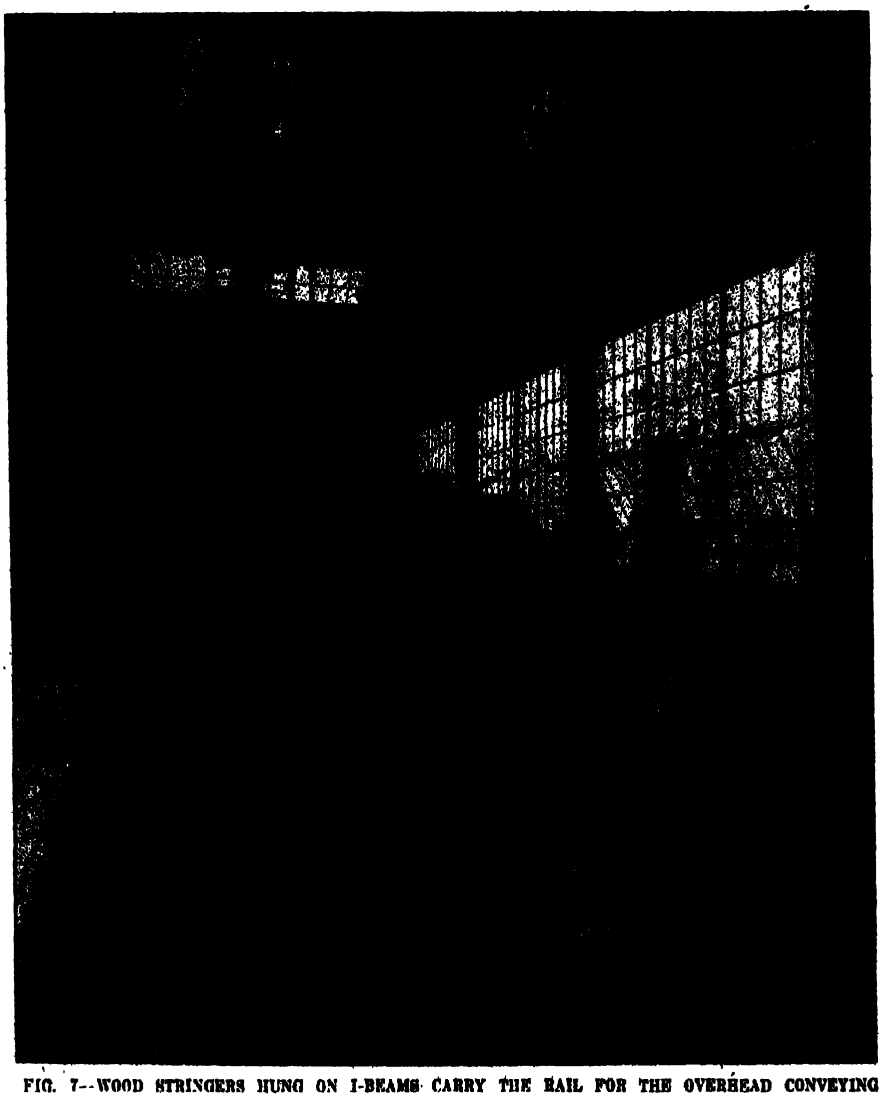


FIG. 7—WOOD STRINGERS HUNG ON I-BEAMS CARRY THE RAIL FOR THE OVERHEAD CONVEYING SYSTEM—NOTE THE RIDDLE ATTACHED TO THE ONE TROLLEY WHILE ANOTHER TROLLEY CARRIES THE METAL FOR POURING

The company specializes in the manufacture of high class bronzes. The castings made for its own use must stand a water pressure test, and the castings made for outside firms must meet rigid specifications. One of the guarantees which the company gives to its customers is that the castings will be within certain limits for composition and will stand prescribed physical tests. In case of failure the company allows credit for the cost of the casting as well as any machine expense which has been put on the defective casting. This naturally makes for conservatism in trying new methods. When work was started in this foundry in Dec., 1919, only 1000 pounds of castings a day were made. This output has been increased until by the first of May production had reached an average of 2700 pounds of cleaned castings a day. This amount is constantly being increased and the company expects soon to have requirements enough to utilize the entire output of electric furnace metal.

The furnace charge is made up of scrap copper wire, bushings or other scrap with any new metal necessary to give the resulting metal the required composition. The wire formerly was compressed into rectangular bales in the cabbaging machine shown in Fig. 9. This machine was built by the Logeman Bros. Co., Milwaukee. About 25 or 30 tightly compressed bundles could be made on it, in an hour. The weight of these compressed

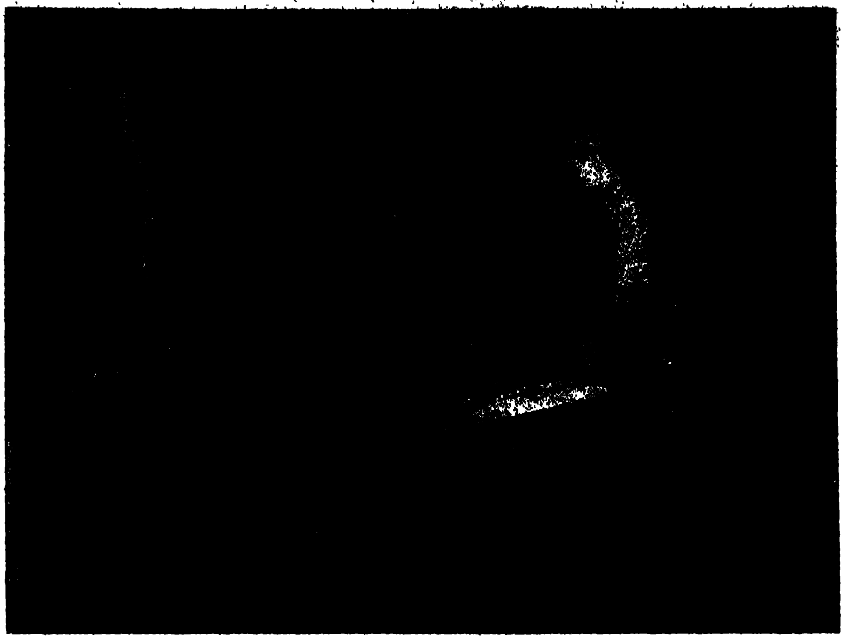


FIG. 9—COPPER WIRE FORMERLY WAS COMPRESSED INTO BALES FOR THE FURNACE—THE AIR COMPRESSOR MAY BE SEEN AT THE LEFT

masses varied somewhat according to the sizes of wire used, but the average bundle weighed about 70 pounds.

The company recently has decided to abandon the use of the cabbaging machine. The space at present occupied by this equipment is badly needed for other purposes. Further, the premium offered by smelters for scrap material for refining makes uneconomical the reclamation in shops where specification limits are rigidly observed.

Charging the Furnace

To charge the furnace, the door above the tapping spout is unclamped and lifted off by a chain block hung on a swinging standard. The door may be seen at *A*, Fig. 4, which shows the beginning of a charge. One block of copper wire is being pushed into the furnace and the others for the charge are on the ground in front of the furnace. After all the copper wire has been placed in the furnace a portion of the smaller scrap is shovelled in and the furnace is rocked slightly to settle the scrap. Then a path is cleared for pushing in one of the electrodes, both of which had been withdrawn before charging was started. Three-inch graphite electrodes are used. The furnace again is rocked and an additional amount of the charge is put in. The second electrode then is pushed into the furnace close enough to the other electrode so that an arc will be made when current is turned on. The remainder of the charge is added, and after the door is closed the furnace is ready to be started.

During the heat, one electrode is held stationary and the length of the arc is controlled by moving the other. This is effected by a screw operated through the wheel *B*, Fig. 4. It is necessary for the melter to be at this wheel constantly during the heat as the electrode needs frequent regulation. The switchboard which carries a wattmeter and a voltmeter may be seen plainly to the right in Fig. 5.

The furnace is held stationary until the charge is almost entirely melted, after which it is rocked. It can not be rocked before this time on account of danger from heavy pieces of metal striking the electrodes and breaking them. The rocking period lasts about 20 to 30 minutes. At first the furnace is rocked through only a small angle, but this gradually is increased until towards the end of the heat the furnace is turned as far as possible without pouring metal from the spout on either side. The furnace is carried on four idler wheels and is rocked by a motor acting through a pinion on the two gears shown in the illustrations around each end of the cylindrical barrel of the furnace. The angle of rocking is regulated by changing a pin in a controller box shown at *C*, Fig. 4.

The furnace is shown tilted back while rocking in Fig. 6. The light spot shown in the hood is caused by the light from the electrodes coming through a small opening at the pouring spout. During the heat the hole at the pouring spout is partly closed with a brick but it is necessary to allow a small opening for the escape of fumes which would exert considerable pressure in the furnace if not allowed to escape. Such fumes are carried away through the hood which has been built close to the furnace to secure a strong draft.

Tapping the Furnace

When the metal is hot enough to pour, the brick is taken from in front of the tap hole and a ladle or crucible is placed on the car which travels on a track to the front of the furnace as shown in Fig. 5. As the furnace tilts it is necessary to bring the container closer to it. This is accomplished by pushing the car with a bar. As soon as the container is full it is taken to a row of metal pig molds and poured into ingots.

FIG. 10—CASTINGS ARE SORTED INTO TOTE BOXES WHEN THEY ARE TAKEN FROM THE SANDBLAST BARREL—THEY ARE CARRIED TO THE SHIPPING DEPARTMENT ON A PUSH TRUCK

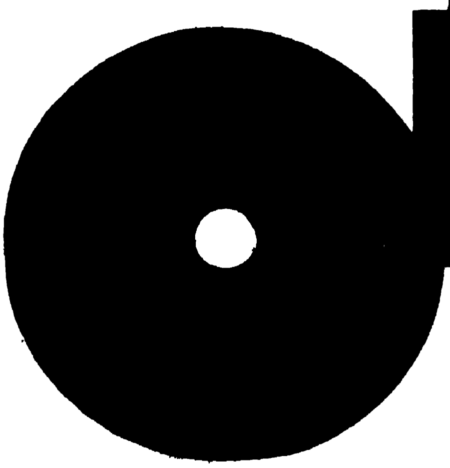
A characteristic day's log of the furnace is shown in Fig. 3. The charge in each case consisted of 230 pounds of scrap bushing and 270 pounds of copper wire. The first heat recorded on this chart was cast April 27. The next heat was the first taken off April 28. It was started at 7:25 a. m. and pouring was begun at 9:00 a. m., which showed 1 hour and 35 minutes for the heat. The total power required was 100 kilowatt hours. Contrasting this with the last two heats of the day which were melted in 52 minutes respectively, and required 63 and 65 kilowatt hours each, the effect of a cool furnace is noted.

Intermittent Operation

After the last heat, the furnace is charged and closed ready to start in the morning, but considerable heat is lost in standing the intervening 15 hours. Were the furnace operated on a 24-hour schedule the average power consumption could probably be kept below 65 kilowatts for the 500 pound charge, and certainly below 70 kilowatt hours. At the latter figure the power consumption per ton of metal charged would be 280 kilowatt hours.

The chart shows that six heats were taken off from 7:25 o'clock in the morning until 4:20 in the afternoon. However, a considerable loss of time is shown between each two successive heats. Twenty minutes elapsed between pouring the first heat and starting the arc on the second heat. Similarly 30, 51, 25 and 20 minutes respectively elapsed between the succeeding heats. The loss of time partly was due to the fact that the metal was poured into a crucible. This necessitated waiting to charge the furnace until the metal from the crucible was poured into ingots and a second tap was made. The furnaceman also helped to pour the metal into ingots, which delayed recharging. If the furnace man is not required to pour the metal he may begin charging as soon as the metal is poured. In this way less than 10 minutes will be consumed from the time of tapping until the arc again is melting another charge, and seven heats can be taken in a day.

Frequent analyses, to check the work of the melter, are made in the laboratory which the company has established. With this information accurate mixtures can be made for melting in crucibles when casting in which scrap metal is permitted to be poured. However, on most of the castings only virgin metal enters into the mixture. The company rigidly adheres to the principle of absolute honesty in all of its products. The chemical composition is guaranteed to the customer, and no substitution, nor cheapening is permitted in any of its metals. The statement is made that no profit is figured on any of the metals which enter into the castings produced, that the costs are figured upon the operations involved, and that, therefore, no excuse exists for substituting metals.



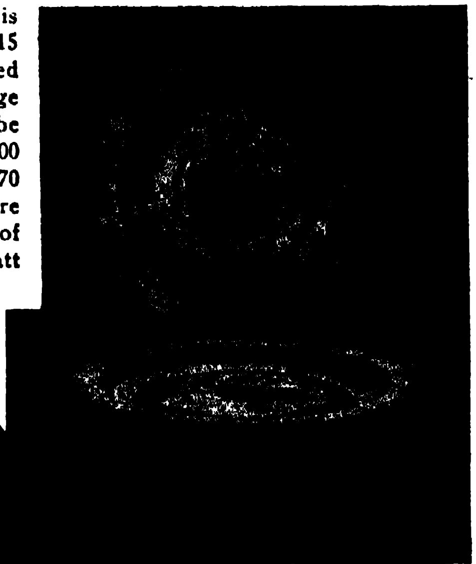


FIG. 1—COMPLETED FLYWHEEL CASTING FIG. 2—STRAINER CORE SEGMENTS AND COMPLETED CORE IN PLACE IN THE COPE

Five crucible pits are used for melting metal for castings. In addition to these, a gas crucible furnace has been added to the melting equipment. No. 100 crucibles are used in four pits and the fifth pit carries a No. 60 crucible. Coal is used as a fuel and it is thought to be preferable to coke. One advantage it has is that enough coal can be placed in the pit when the crucible is charged to last through the heat, whereas an addition must be made during the middle of the heat when coke is employed. About 0.55 pound of coal is required to a pound of alloy.

John J. Murray has been appointed eastern sales representative for the Canton Steel Foundry Co., Canton, O. with offices at 120 Broadway, New York.

Uses Special Strainer On Flywheels

The Nash Motor Co., Kenosha, Wis., employs an efficient method for producing flywheel castings for its 6-cylinder passenger automobile. One of those castings is shown in Fig. 1. The main consideration in a casting of this nature is clean metal. To secure this the special skim gate, *A*, shown in place in the cope in Fig. 2 is employed. This gate is formed of three separate cores, which are shown leaning against the cope. The core to the right forms the top, while the plain ring core is the center and the one to the left is at the bottom and opens into the mold. The three cores are pasted together and baked. The strainer thus formed is set and rammed in place with the cope forming the bottom of a box cut into the top of the cope.

The coreboxes used in forming the perforations in the top and bottom disks have pins which cut the small holes in the upper and lower sections, almost entirely through the core. After the sections are baked, they are sent to a small bench drill, which is used to cut the holes entirely through the core. The boss shown at the center in the drag comes in contact with the center of the skim gate core and forms the opening shown in the flywheel casting.

At the Nash plant four men and a separate pouring gang during last winter produced 180 flywheels per day using two molding machines, one for the cope and the other for the drag. As the operation is practically continuous, the problem of floor space, to keep the work as close to the machine as possible, is important. Conservation is accomplished by pouring a floor of molds as soon as it is ready, and then placing additional molds upon the tops of those already poured. A night gang shakes out the castings and prepares for the following day's production.

A Correction

In the description of the Long & Allstatter Co. foundry, Hamilton, O., which appeared in the June 15 issue, the name of the maker of the heating equipment was erroneously stated. This equipment which comprises three large air heaters was manufactured by Skinner Bros. Mfg. Co., Inc., 1022 Tyler street, St. Louis.

The National Engineering Co., Chicago, manufacturer of the Simpson foundry mixer, has changed its eastern office to 1760 Woolworth building, where S. H. Cleland will have charge as eastern sales manager.

Making Foundry By-Product Coke

Proper Blending of Coals and a Knowledge of the Ratio of Heat Applied to the Oven Area Is Essential—Some Common Points to Observe in Judging Coke Are Noted

BY EDWARD H. BAUER

WHEN coal is pulverized, mixed with air and ignited, it can be made to explode. This is due to minute particles of coal being surrounded by an atmosphere of oxygen in sufficient quantities to support complete combustion in a short space of time. A 1-inch cube of coal will have 6 square inches of surface exposed to the air or oxygen, but if this same 1-inch cube is pulverized, the area exposed to the oxygen will be thousands of times greater and, consequently, if coal is ignited in this state, the burning will be so rapid it may be called an explosion. Coke under the same conditions will act in a similar manner.

From this, it is seen that coke which exposes a large surface to the blast will burn more readily than one which is dense and compares with a hard coal such as anthracite. Hence, a foundry coke must have an open cell structure in order to expose a large area of it to the blast. Further, the coke in the bottom of the cupola must carry the weight of all the burden above it and, therefore, must have sufficiently strong cell walls.

The cell structure in the coke may vary from what is termed *sponge* to a degree so hard as to almost compare with anthracite. Naturally the dense coke will carry more burden than sponge and the sponge will burn faster than the dense coke. Therefore, a good foundry coke should have both characteristics. The cell structure should consist of hard, thin walls, but the walls at the same time, should be strong. As John Fulton, the pioneer investigator of coke, expressed it, "Furnace gases cannot operate on cell space; they can

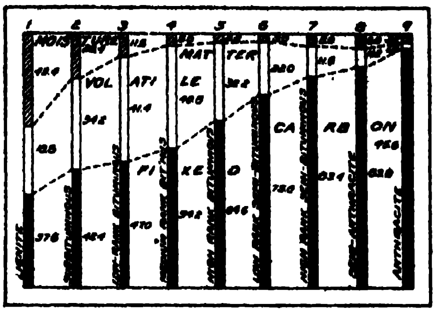


FIG. 1—GRAPHIC REPRESENTATION OF THE CHEMICAL COMPOSITION FOUND IN VARIOUS RANKS OF COAL

only act on the exposed surfaces." Therefore, the space is nothing and cannot be used, but the cell wall and the surfaces which are exposed are the important factors.

The structure of the cell wall varies with different conditions under which the coal is coked, such as heats and length of coking time, and also varies with the characteristics of the original coal. Ash content of the coal will tend to strengthen the cell walls, but this ash must be in the correct form. Large particles of ash or inorganic matter will decrease the strength of the coke, as explained later, but finely divided inorganic material will actually strengthen the walls.

If the coke is undercoked, the cell walls will be soft and, consequently, if the volatile matter in the coke is too high, we can safely state that the coke is soft and will not carry the burden but will *mush* down in the cupola. Overcoking will tend to break into smaller pieces, with a better cell wall, but will have a tendency to produce a fingery structure. If the ash is too high, much inert material will be needlessly heated to the fusing point and the efficiency of the cupola lowered. Sulphur in coke mixes with the molten iron in the cupola and produces hard castings. Moisture plays an important part in coke quality, but is overlooked by many. If coke is quenched properly, the moisture will remain low, although the coke is rained on in transit.

The analysis of an ideal foundry coke should be within the following limits:

	Per cent
Volatile Matter	2 or less
Fixed carbon	86 or more
Ash	12 or less
Moisture	2 or less
Sulphur	Less than 1

Some operators seek coke containing moisture plus volatile matter in quantities less than 2 per cent. In order to

Abstracted from a paper presented at a recent meeting of the New England Foundrymen's association. The author, Edward H. Bauer, is engineer of manufacture for the Providence Gas Co., Providence, R. I.

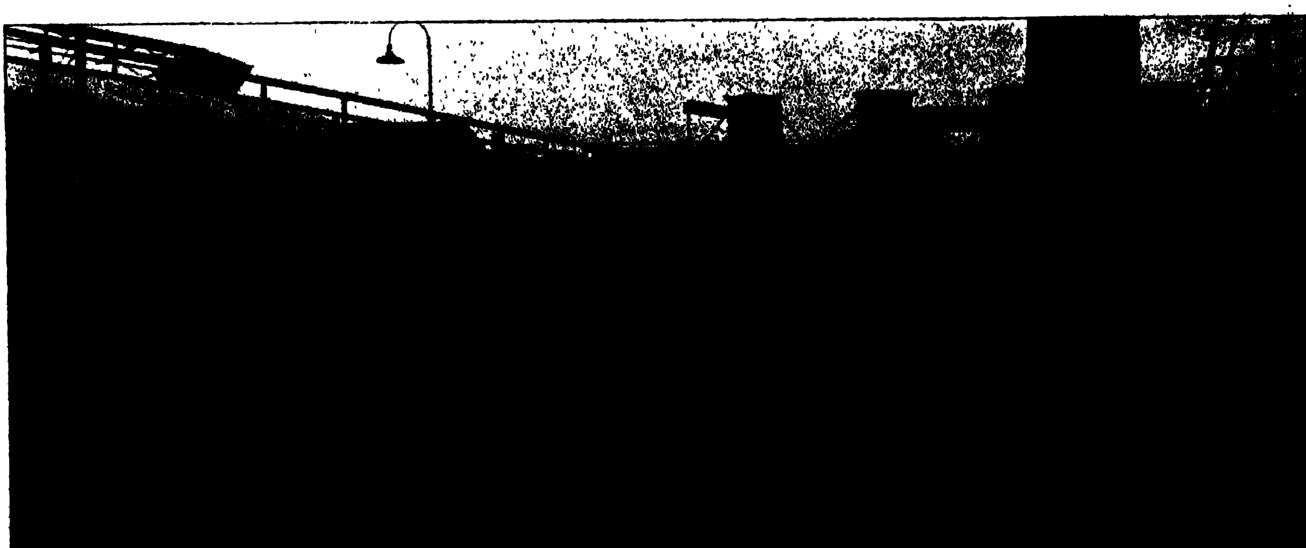


FIG. 2—FINELY PULVERIZED COAL IS FED INTO THE COKING OVENS FROM FOUR HOPPERS

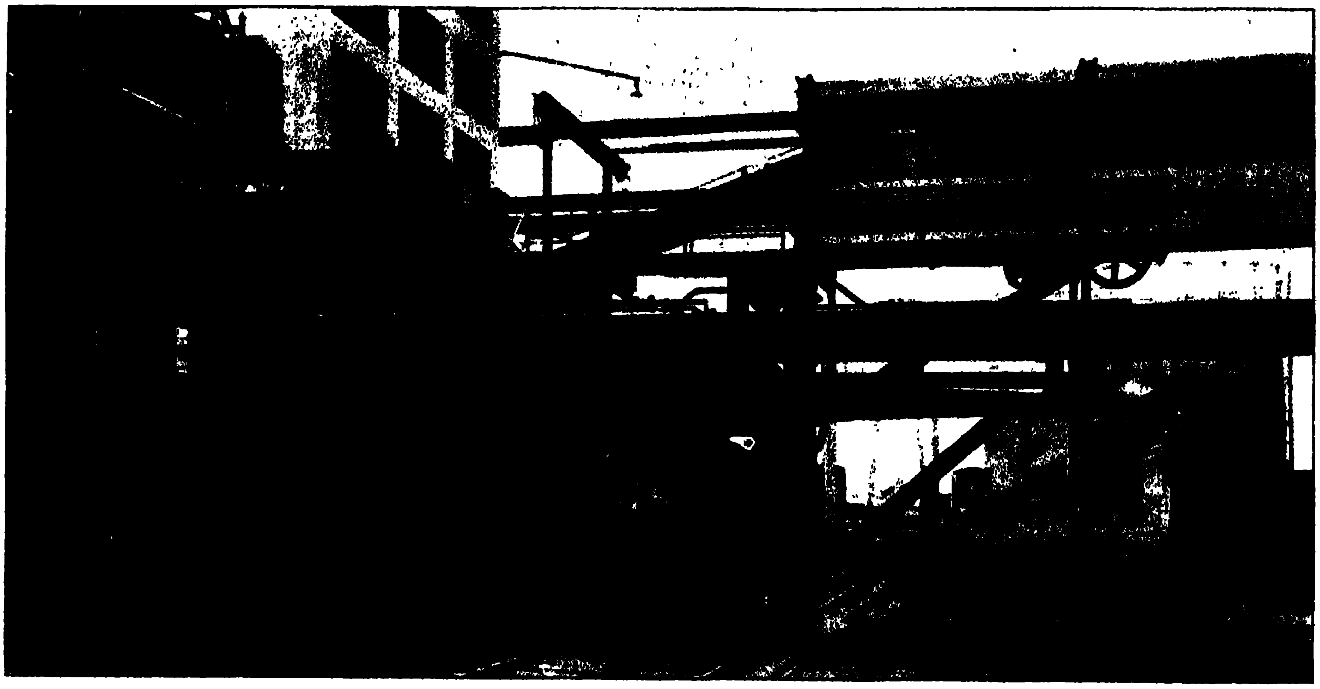


FIG. 3—THE MECHANICAL EQUIPMENT FOR OPENING OVEN DOORS, LEVELING THE CHARGE, AND PUSHING THE COMPLETED COKE INTO CARS IS CARRIED ON ONE TRAVELING FRAMEWORK

drive off the last traces of volatile matter and bring the moisture plus the volatile matter down to such a low percentage, it will be necessary to overcoke part of this coke and thus decrease the size of the lumps.

Coal is of vegetable origin. Through the ages this original vegetation, pressed between heavy layers of rock and subjected to heat, has been converted into what is now termed coal. However, all of this vegetation has not been subjected to the same treatment and probably some of it, while under the same heat and pressure conditions, has not been exposed to the treatment so long and, consequently, the coals of today vary in physical and chemical characteristics.

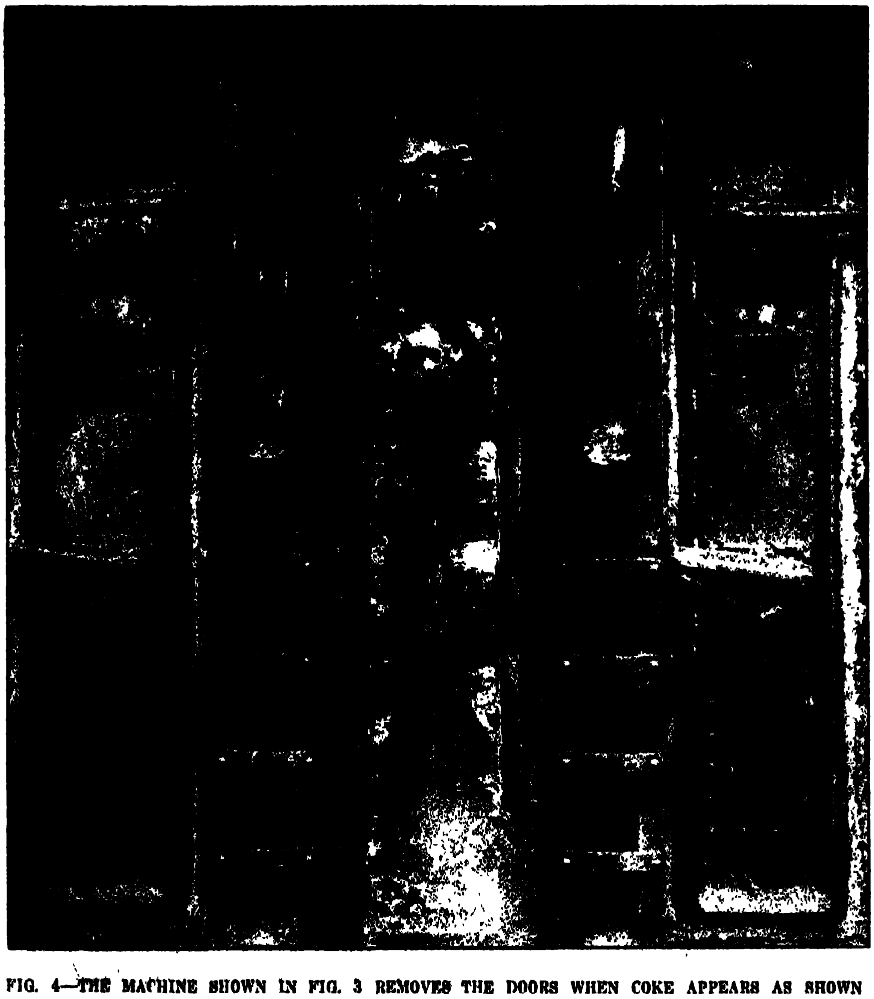


FIG. 4—THE MACHINE SHOWN IN FIG. 3 REMOVES THE DOORS WHEN COKE APPEARS AS SHOWN IN THE CENTER OVEN, READY TO PUSH

Elements are Similar

Analyses show that the original matter from which coal was formed and the coals of today contain the same elements, namely: carbon, hydrogen, oxygen, nitrogen, sulphur and ash combined in widely different proportions. Analyses also show that changing this vegetation from the decayed mass into coal, through the agencies of pressure, heat and time, consists of the elimination of carbon, hydrogen and oxygen in the forms of carbon dioxide and methane. In other words, the analyses of various coals, from lignite up to anthracite or even graphite, show that the volatile matter and moisture have been gradually driven off and the fixed carbon left behind. Fig. 1 shows this clearly.

There is still another constituent of coal to be considered, and that is resinous matter by virtue of which coal cokes. Coal is an agglomerate of carbon residuum, humus bodies, resinous bodies and hydro-carbons in various proportions. Certain combinations of these bodies give the coal its classification, and in order to have a coking coal, the above bodies must be in correct proportion. If they are not, no coke results.

The high volatile coal—commonly known

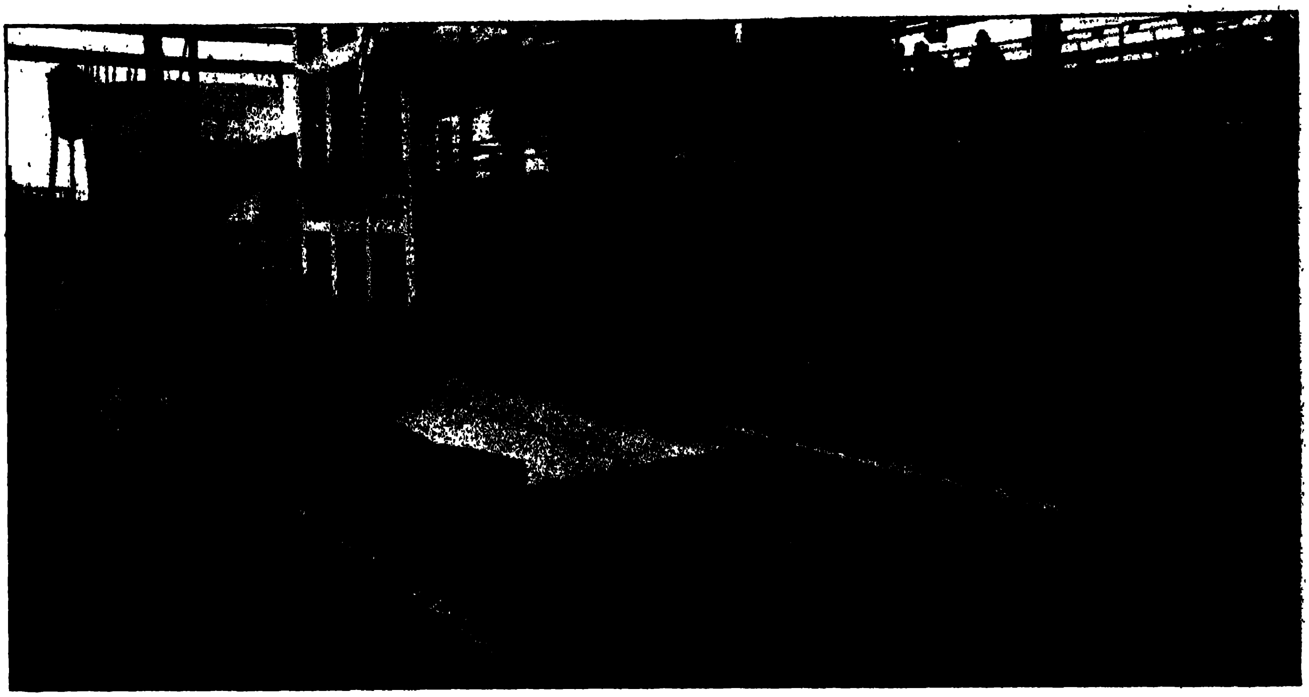


FIG. 5 THE HOT COKE IS PUSHED OUT BETWEEN THE GUIDES AND INTO THE QUENCHING CAR FOR REMOVAL TO THE QUENCHING TOWER—THE DELIVERY WHARF IS VISIBLE BELOW THE ELECTRIC LOCOMOTIVE

as *gas coal*—contains from 30 to 40 per cent of volatile matter. It cokes to a certain extent but the coke is friable, has thin, soft walls and is porous. This coal is used in gas works where metallurgical coke is not made. The resulting coke from this coal usually is termed *gas house* coke.

Coking coals have slightly less volatile matter but give a better coke than that made from gas coal but the product will not carry a heavy burden.

Mixing for Quality

Low volatile coal is sometimes called *steam coal.* This is the New River or Pocahontas quality. It contains from 17 to 22 per cent volatile matter, expands on coking, gives a dense coke and is used by mixing a certain portion with the higher volatile coals, to give the resulting coke the proper qualities. All low volatile steam coals cannot be used in the manufacture of coke, but all low volatile coking coals can be used for steaming purposes. Unless these coals contain the proper proportions of humus and resinous bodies, the resulting coke cannot be used for metallurgical purposes.

It is obvious that coke made from either of the three mentioned coals will not give a coke that is suitable for foundry practice, but it has been found that a mixture of these will give an excellent coke, provided the mixture is in correct proportion to suit the conditions of the heat to which it is subjected and the type of oven in which it is coked. A mixture of coals which in one oven with certain heats would give an excellent coke could not be used in an oven of a different type which gives a different heat treatment. For instance, if a certain mixture of high and low volatile coals is handled in two ovens, one 24 inches and the other 17 inches wide, the coking time necessarily will be different with a consequent different heat treatment in the two ovens. This difference in coking time will re-

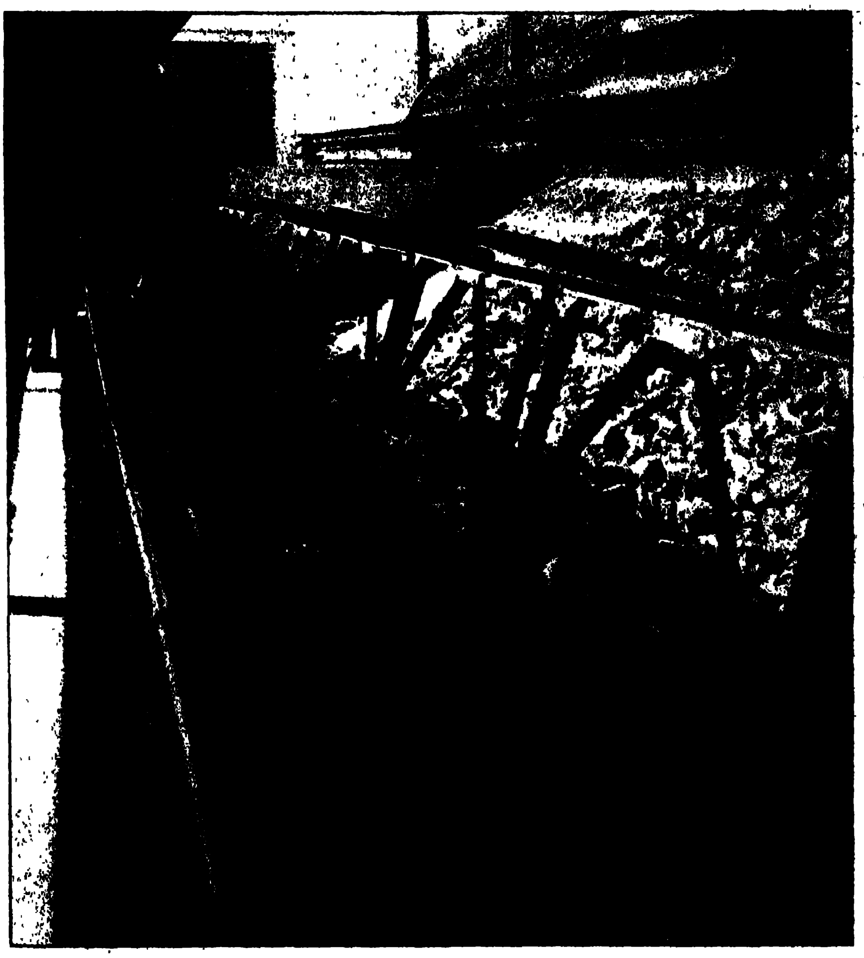


FIG. 6—THE RECEIVING WHARF HOLDS THE COKE AND PERMITS IT TO BE FED REGULARLY UPON DELIVERY BELTS THAT RUN BELOW

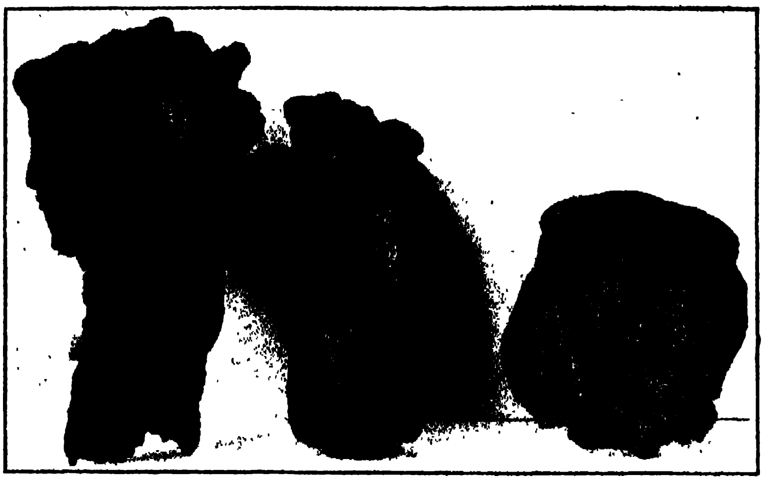


Fig. 7—Coke made of 100 per cent high volatile coal having approximately 28 per cent volatile matter. The two pieces on the left show coal coked in 15 hours, while the piece to the right shows the same coal coked in 30 hours. The short coking time shows the effects of high heats in giving a fingery coke, open cell structure and much cross fracture. The coke made with longer coking time shows a better cell structure, less cross fracture and a more blocky coke.

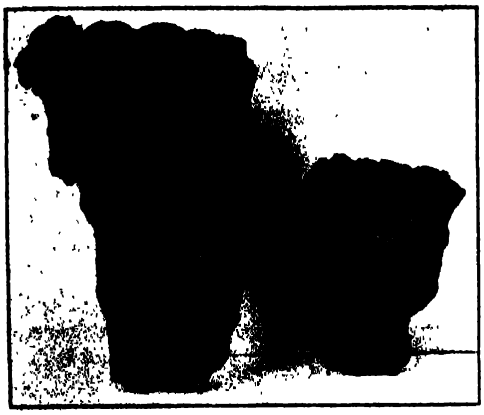


Fig. 8—Left—Coke made of a mixture of 89 per cent high volatile and 11 per cent low volatile coal on 24-hour coking time. This high volatile contains approximately 31 per cent volatile matter. The low volatile contains about 18 per cent. Note the large cell structure, the longitudinal fracture and the irregular cross fracture which is shown by the piece on the left. The piece to the right shows an end view of the cross fracture. Note the fingery structure of this coke. Coke of this type dropped 6 to 8 feet will break into small pieces.

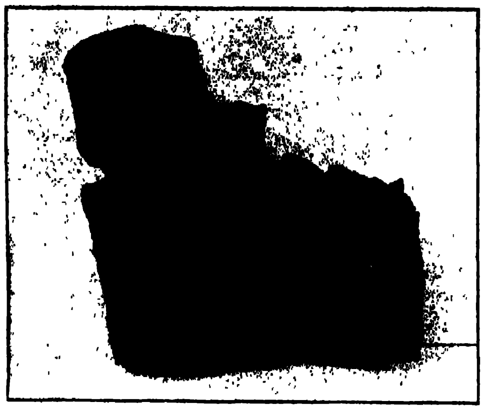
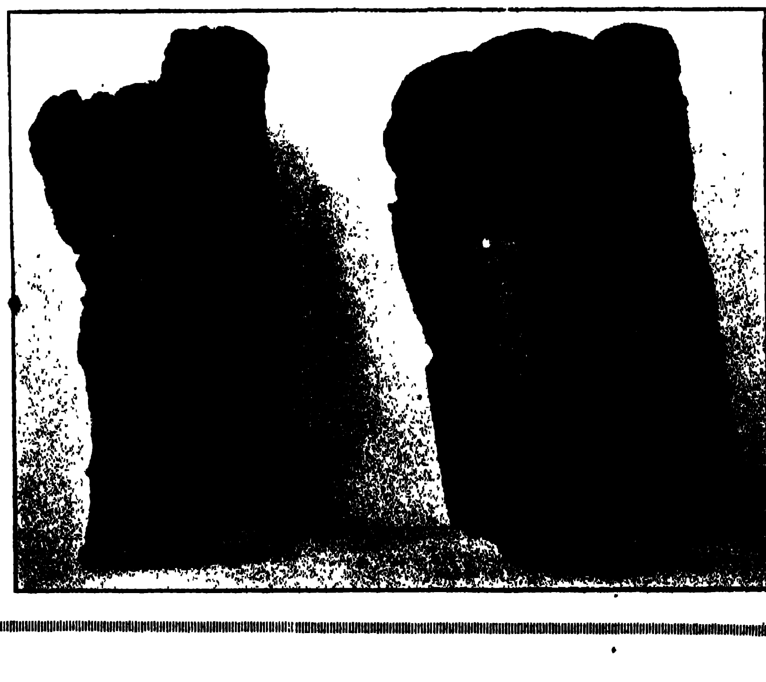


Fig. 9—Right, above—Coke from a mixture of 70 per cent high volatile and 30 per cent low volatile of the same coal. The addition of the 19 per cent low volatile did not help the cell structure to any marked extent but decreased the longitudinal fracture. This did not prove to be a good metallurgical coke, the cell walls being too soft.

Fig. 10—Two pieces of foundry coke. The one to the left is made of 60 per cent high volatile Pittsburgh coal and 40 per cent New River on 24-hour coking time. Note that the coke made with this coal gave a great deal of cross fracture. It held together well and stood a fair shatter test. The coke to the right is made from 35 per cent Pittsburgh coal, 30 per cent high volatile gas coal and 25 per cent New River, coked under the same conditions as the piece to the left. The one to the right shows less cross fracture and it is a better quality of coke, although dense. The addition of the 30 per cent high volatile gas coal has eliminated a great deal of cross fracture.



sult in either overcoked coke in the narrow oven or a much undercoked coke in the wide oven.

Coal as received from the mines is usually what is known as run-of-mine coal. This contains some tramp iron which is lost in the mines, pieces of slate falling from the roof of the mine, sticks, *sulphur balls* or iron pyrites in various forms, etc. This coal which varies in size from dust up to lumps a foot or more in diameter, is placed on belts when received at the plant and is conveyed to what is known as the breaker and cleaner. The breaker used at the Providence plant consists of a large drum approximately 12 feet in diameter and 14 feet long. The shaft on which the drum rotates is on a slight angle, the coal inlet end being slightly higher than the refuse discharge end. The shell of the drum is perforated steel plate and inside of it are lifting plates, which lift the coal to the top of the breaker, allowing it to fall on the screen plates below. This fall breaks the coal, allowing it to pass through the 1½-inch perforations into a hopper below. Any tramp iron or exceedingly hard coal, sulphur balls, stones, slate, or other refuse gradually is worked to the lower end of the breaker, where it is discharged into a chute which leads to a bin. This breaker is housed in a steel casing which keeps in the dust. It is operated at approximately 12 revolutions per minute.

The coal, after passing through this perforated screen plate, falls into either one of two bins. One bin is used for high volatile coal; the other for low volatile coal.

Directly below these bins are located two mixing belts, which are moved at different speeds, one approximately twice the speed of the other. The coal is fed onto the belts and the height of the coal streams on the belts regulated by

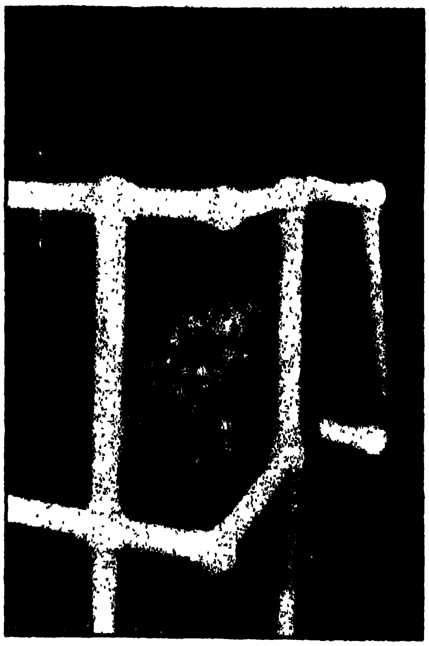


FIG. 11—A SERIES OF ROTATING DISKS CONSTITUTE THE GRIZZLY OR AUTOMATIC SCREEN WHICH SEPARATES FINE PARTICLES FROM FOUNDRY GRADES

rates. This gives the right proportions of high and low volatile coals required to secure the proper qualities in the coke.

This machine is equipped with an electrical device, by which the belts are stopped if the coal *hangs up* in one of the bins or if one of the coal bins becomes empty. In this way, the correct coal mixture always is obtained.

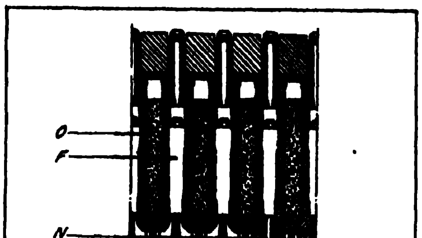
From the mixing belts, the broken coal falls directly into what is known as a *hammer crusher*. As it falls into the chute leading to the crusher, it is retarded by a paddle feeder, which allows only a certain amount of coal to pass into the crusher at one time and insures a steady and uniform supply.

The crusher consists of a row of steel bars or hammers, as they are called, fastened to disks which are mounted on the shaft of the crusher. These disks and hammers revolve at about 800 revolutions per minute and drive the coal through a perforated steel screen. The perforations are approximately ¼-inch in diameter. The perforated screen can be raised or lowered so as to bring it nearer to or remove it farther away from the edge of the hammers, and in this way increase or decrease the pulverizing effect.

The crusher will pulverize the coal so that 95 per cent of it will pass through a ⅛-inch square mesh sieve, and any ash which the coal may contain also is pulverized thoroughly and, therefore, the ash is put in a condition whereby it will tend to strengthen the cell wall instead of to decrease the strength of the coke.

After passing through the hammer crusher, the coal is delivered upon belts, which carry it to the prepared coal bin directly over the ovens. From this bin the coal is drawn into a motor-driven charging larry, which carries four steel funnel-shaped hoppers. These hoppers are moved into position across the top of the oven which is to be charged and coal is dropped into the oven through gates directly beneath. The charging equipment is shown in Fig. 2.

The coke plant of the Providence Gas Co. is one of the most modern. It is composed of 40 Koppers combination, cross-regenerative, coke ovens complete with the latest and most modern



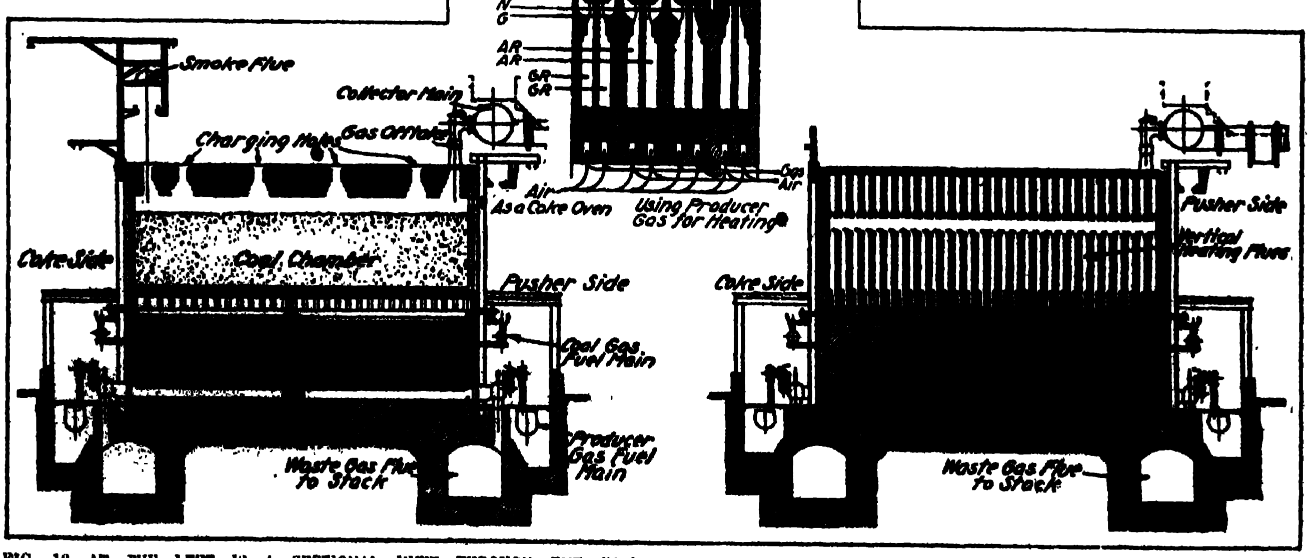


FIG. 12—AT THE LEFT IS A SECTIONAL VIEW THROUGH THE COAL CHAMBER—AT THE RIGHT—A SECTION THROUGH THE HEATING CHAMBER. ABOVE—CROSS SECTION OF A BATTERY OF OVENS

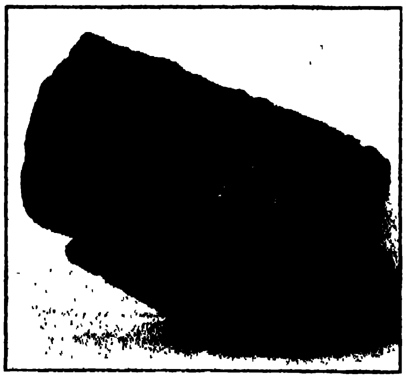


Fig. 13—Above—Coke made with a mixture of 65 per cent high volatile gas coal and 35 per cent New River on 19-hour coking time. Note that the coke is blocky. It has a cross fracture which seems to divide the coke into three sections. Nevertheless this fracture does not extend through the coke and it held together well.

Fig. 17—Above—Coke made from a mixture of 70 per cent high volatile gas coal and 30 per cent low volatile New River coal. The heats in the ovens were too high with consequent fingery structure of the coke and irregular cell walls.

Fig. 14—Above—A piece of coke broken in two to show the irregular cross fracture obtained if the heats are too high and the coal mixture is not correct for the heat used.

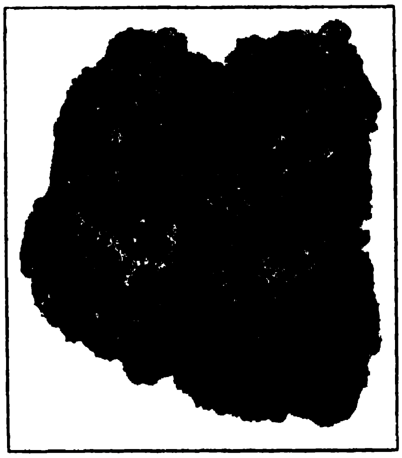


Fig. 18—Right—The coke sponge formed in the oven when a high volatile coal is coked or the coal mixture contains a large percentage of high volatile coals and when the oven is hot. Some coal mixtures when coked in one width of oven will have a great deal of sponge, while if coked in a different type of oven the sponge will practically be eliminated. These pieces of sponge all have to be picked from the belt as the coke is being loaded into cars; otherwise the percentage of breeze in the car will be extremely high.

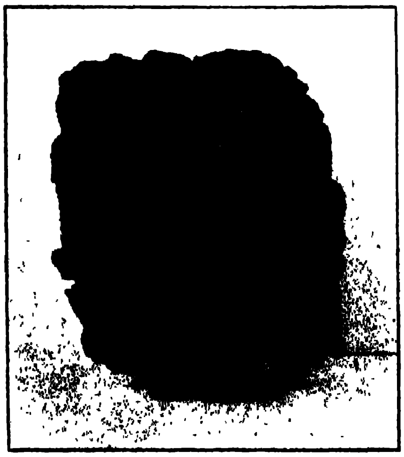


Fig. 15—Left—The result of using a high ash coal which has not been pulverized. To make the resulting coke show the effect of a high ash coal and no pulverization, a small amount of anthracite buckwheat screenings was added to the coal. Anthracite in coke gives the same results as ash. Note that wherever a piece of ash is seen in the coke, a fracture is started. If this piece of coke were dropped 4 feet it would break into very small particles.

Fig. 16—Right—The wall end of coke of the same quality as that shown in Fig. 13, above and at the left

equipment for handling and preparing the coal and finished product. The ovens each have a capacity of 11.4 tons of coal and, as they are designed for 15-hour coking time, it brings the total carbonizing capacity up to about 750 tons of coal per day. This figure can be increased somewhat if necessary, as tests have shown that the coking time can be less than 15 hours.

The ovens are 37 feet long inside, face to face of doors, and have an average width of 17 inches. The total depth of the oven chamber is 9 feet 10⅝ inches. The depth of the coal charged is about 9 feet. The oven has a capacity of approximately 460 cubic feet.

The heating walls of the ovens are built of silica brick, which offers the best heat transfer. The face walls of the ovens are clay brick, as is the floor and the larger part of the checker brick in the regenerators. At the ends of the battery are two concrete pinion walls, which hold the ovens in place. These pinion walls are built monolithic with the oven pad, so that longitudinally the battery is set in a concrete box with the sides and top removed. These end pinion walls also are held together at the top by long tie rods. The oven faces are held in place by buckstays set in the concrete at the base and are held together at the top by cross tie rods.

Combination Ovens Used

The ovens are designed to burn either coke oven gas or producer gas as fuel or, if necessary, a combination of the two gases. In the summer, with a big demand for foundry coke and a demand for gas below that which the ovens will produce in turning out the required coke, the producer plant will be practically inoperative and coke oven gas, after it has been cleaned, will be returned to the battery for heating. Reverse the condition, 100 per cent gas is made to meet the demand and the excess coke is used in the producers.

Fig. 12, at the right, shows a vertical cross-section through the center line of the heating flues. The D-shaped mains located in the trench on each side of the oven are used for producer gas. The small round main located just above the producer gas main is for returned coke oven gas. The waste heat flues are located partly under the regenerators on each side of the ovens. The air boxes or a combination of air and gas box lead from the bottom of the regenerator into the waste heat. Their functions will be explained later.

There are 30 heating flues, each of which is connected to the regenerator below it by a separate port. The coke oven gas gun is connected into the bottom of each one of these flues by a nozzle. The regenerators are divided in the center, as are also the coke oven gas flues. A horizontal flue is located at the top of the vertical heating flues. The openings between the horizontal flue and the vertical flue can be adjusted by the small sliding bricks as shown. These sliding bricks can be so arranged that a uniform distribution of heat is obtained throughout the entire length of the battery.

Adjusting the Gas

Gas is allowed to burn only on one-half of the battery for half an hour. The valves and dampers are set as follows, with gas burning on the pusher side: The waste gas flue to the stack on the pusher side is closed by the stack reversing damper. The coke side is open. This puts the suction on the coke side of the battery. The air valves on top of the air boxes which connect the bottom of the regenerator to the stack flue are open on the pusher side. The gas cocks are open on the pusher side, allowing the gas to enter the gas gun, then pass through the nozzles to the base of the heating flues on the pusher side. Here the gas meets the air which has been drawn through the opening in the top of the air box into the regenerator, where it becomes heated, and burns up through the vertical flues. Just enough air and gas is allowed to enter the flue to give complete combustion in the vertical flues, no combustion being allowed in the horizontal flue. The waste gases or products of combustion pass along the horizontal flue down through the vertical flues on the coke side, through the regenerator, where they heat up the checker brick, and through the air box on the opposite side (the damper on the top of which is closed) and then into the waste gas stack flue to the stack. At the end of the half-hour period, the dampers are reversed and the gas is burned on the coke side.

Fig. 12, at the left, shows a longitudinal cross-section through the battery. This shows the regenerators underneath the ovens, the heating flues and coke chambers.

When producer gas is used, each alternate regenerator is used for air or gas and each regenerator is divided by a thin wall. This thin wall facilitates the adjustment of the air into the heating flues on each side of the oven chamber. By this arrangement there is a heavy wall between the regenerator which has producer gas in it and the regenerator which contains coke oven gas. Producer gas, having a low heating value per cubic foot, must be regenerated before it is burned in the heating flues in order to obtain the best results. When heating with producer gas, the process is similar to that of coke oven gas with the exception that the air boxes which lead the producer gas into the base of the regenerators have an additional damper, which closes the passage between the air box and the waste gas flue, and the dampers on top of these air valves are bolted down. The air valves used for the air are the same as when coke oven gas is used.

The upper drawing in Fig. 12 shows a cross section through the regenerator and the coal chamber. It shows charging holes through which the coal is dropped, collector main at the right side and the offtake pipe which leads the gas from the top of the coal chamber into the collector main.

The air and the gas entering the heating flues may be adjusted to obtain a short flame or a long flame, thereby this area of heating can be raised or lowered, so as to keep the bottom of the oven hot with the top cold, or the flame can be gradually raised so as to place the point of heat application at any desired point. By adjusting the sliding brick at the top of the flues, if the center of the oven shows cold, more gas and air can be drawn through the flues opposite the cold part and the heats of these flues thereby made equal to that in the remainder of the flues. Therefore, it is obvious that with this type of oven, the regulation of the heat always is under the control of the operator.

Cooled at the Top

The location of the horizontal flue below the top level of the coal insures a cool top and, therefore, a maximum by-product recovery from the gas is obtained.

Fig. 2 shows the top of the ovens and the standpipes which lead the gases from the ovens into the collector main. Fig. 3 shows the combination pusher, leveler and door extractor. This machine is used to level off the coal after it is dumped into the oven. This leveling is necessary to provide a space above the top of the coal which allows free passage for the gas away from the coke. A heavy ram is used to push the coke out of the oven. This ram is about 70 feet long and passes through the entire length of the coking chamber. The door extractor is used to lift the door from the oven previous to pushing the coke out.

The coke in the oven after the door has been removed ready for pushing is indicated in Fig. 4. Note the parting line at the center of the oven. The coking process will be explained later and the reason for this parting line given at that time. Fig. 5 shows the

coke side of the ovens, the door machine in the act of taking off a door and the coke guide which is placed in front of the oven to be pushed to confine the coke as it is pushed across the bench. This also shows the quenching car ready to receive the coke as it is pushed out of the oven. An electric locomotive is used to convey this car from the ovens to the quenching station and back again to the coke-wharf, which is shown just to the left of the picture at a point just opposite the electric locomotive. The gates shown in Fig. 6 hold the coke on the wharf and when open allow the coke to slide onto a feeder, which feeds the coke upon a belt. The belt, in turn, leads the coke to the foundry screening station, where a rotary grizzly or screen, consisting of disks, spaced 2½ inches apart, rotating on a shaft, convey the coke across, allowing the small particles to drop between the disks. Only coke which is larger than 2½ inches in diameter passes over this grizzly. Fig. 11 shows the grizzly in action.

The Coking Process

As stated previously, the walls of the coal chamber are heated by burning gas in the heating flues and this heat is transferred through the wall and into the coal which has been charged into the oven. When the coal touches the hot wall, it starts to melt. It does not burn, but melts forming a tarry, pitchy mass, approximately ½-inch in depth. This tarry mass seems to insulate the coal in the center of the oven from the heating wall. Further heat being applied to this tarry mass boils it and the boiling drives off the volatile matter, leaving behind the coke. This, as has been explained before, is due to the resinous, humus and carbon constituents of the coal. As further heat is applied this tarry partition moves in toward the center of the oven. The gas being driven off passes through the coke which has been left behind and the hydrocarbons passing the heated coke deposit more carbon onto the coke cell walls.

This process tends to build up the cell wall and, therefore, on a long coking time, the walls are thicker but softer. On a short-coking time, the walls are thinner but somewhat harder, due to the difference of the deposition of the carbon on the cell walls. This process takes place until the tarry masses meet in the center of the oven, completing the coking of the coal charged. This parting line was visible in Fig. 4. The speed at which this tarry partition travels inward varies with the heat application and also with the width of the oven. The rate is somewhat less than ½-inch per hour or a total coking rate of less than 1 inch per hour. On some of the modern ovens, this time has been shortened quite a good deal.

When the coke is pushed from the oven and slides into the quenching car, it is red hot and must be quenched or it will burn, due to coming in contact with the air. The car of hot coke is pushed under the quenching station, where approximately 5000 gallons of water is dashed over the entire mass.

Just enough water is sprayed on the coke to quench only the outside, leaving the inner part hot. The larger pieces of coke, if broken open just after quenching, will be found red hot on the inside.

After quenching, the car is allowed to stand a few minutes to drain off the excess water and then the coke is hauled to the coke wharf. On the coke wharf, the coke is allowed to stand for a few minutes while the excess water is driven off of the outside of the coke by the heat which is still retained in the center. With this method of quenching, coke may be obtained with less than ½ of 1 per cent moisture. However, care must be taken not to underquench the coke, for should it be loaded very soon after it is placed on the wharf, some of the larger particles may break in two in passing into the railroad car, exposing the red hot center to the air, and thus start a fire in the car.

Foundry coke that had been quenched properly was left in the storage pile over a year, exposed to rain, snow and ice. This coke when analyzed was found to contain only 6 per cent moisture. If coke is quenched until it is cold, the inner cells will draw in water which cannot be driven off by air drying, but if quenched as above, the inner cells will be dry, and if submerged in water will not absorb water and, therefore, it will dry readily if exposed to the air while in storage.

A good metallurgical coke will have a metallic ring to it unless it contains a large number of cross fractures.

In a cupola it is desirable to burn the coke to carbon dioxide (CO_2) as fast as possible; combustion to take place where it is in contact with the iron. In theory, if too small a coke is used, a great deal of carbon monoxide (CO) will be formed in the upper part of the charge by the action of the carbon dioxide (CO_2) on the carbon of the coke in the upper part of the charge. This carbon monoxide (CO) which is generated passes up through the cupola and will burn at the top with a bluish flame. This condition also arises when the coke used is too soft. Excess of blue flame at the top of the cupola then indicates one of two things: too small a coke or too soft a coke or possibly a combination of both. Excess of blue flame is actually a good indicator of losses due to the formation of too much carbon monoxide (CO).

If large pieces of coke are used in the bottom of the cupola, the surface exposed to the air for combustion will be greatly reduced, and the efficiency of the cupola will be reduced, as the rate of combustion is slower than it would be with smaller pieces of coke.

If the coke is soft, naturally large pieces must be used to carry the burden, but if the coke is of the correct structure, smaller pieces can be used, which will give greater surface and, consequently, better efficiencies.

There is another point with respect to the large coke. These large pieces or blocks of coke all have points, corners and loosely connected particles attached to them, and when coke of this kind is dumped from the car to the storage yard, transferred from the storage yard to the foundry and then dumped from the charging floor into the cupola, these smaller particles are knocked off and are practically lost as far as fuel for the cupola is concerned. Care must then be taken to obtain a good, fair sized coke of a firm texture, free from fingery structure.

Teaching Management

The Pennsylvania State College, State College, Pa., will hold its summer course in Industrial Organization and Management, Aug. 9 to 15. This year will be the fifth consecutive session of the course. The purpose of the instruction is to assist men in the development of their positions, to broaden their vision of the possibilities of the science of management, and to illustrate to the student by practical examples the most effective methods of modern organization.

Starts New Furnace

Steel now is being melted by the Black Steel & Wire Co., Kansas City, in a 10-ton open-hearth furnace with a maximum output of 30,000 pounds, installed by the McLain-Carter Furnace Co., Goldsmith building, Milwaukee. The steel is being poured in 4, 6 and 8-inch ingots for rolling into rods. It is expected that the 4-inch ingots, after being cast will be rolled into rods with only one heating. The Black Steel & Wire Co. specializes in the manufacture of wire, wire rods, etc.

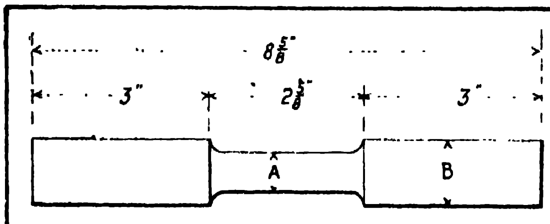
R. K. Morse recently has been appointed western manager for the Milwaukee Electric Crane & Mfg. Co., with offices in the Pittock block, Portland, Oreg.

Variables Bias Malleable Tests

The Relation Between the Tensile Strength and the Percentage of Elongation and the Diameter of Rough and Machined Specimens is Shown in Graphically Expressed Data

BY H. A. SCHWARTZ

THAT machining greatly weakens malleable cast iron is a wide-spread though not necessarily correct belief. In justice to the engineer, who as a basis of design must know how nearly the specified properties may be attained in the sections he proposes to use, the reasons for this belief should be investigated. If the belief is ungrounded, it should be discredited; if it is well founded, the necessary data to prove it such should be available. When specimens of malleable cast iron of various cross-sectional areas, including both machined and unmachined specimens, are tested, a number of variable factors may influence the physical properties.



A	B
1/4"	5/8"
3/8"	3/4"
1/2"	7/8"
5/8"	1"
3/4"	1 1/8"
7/8"	1 1/4"
1"	1 3/8"
1 1/8"	1 1/2"
1 1/4"	1 5/8"
1 3/8"	1 3/4"
1 1/2"	1 7/8"

FIG. 1—DIMENSIONS OF TEST SPECIMENS AS CAST

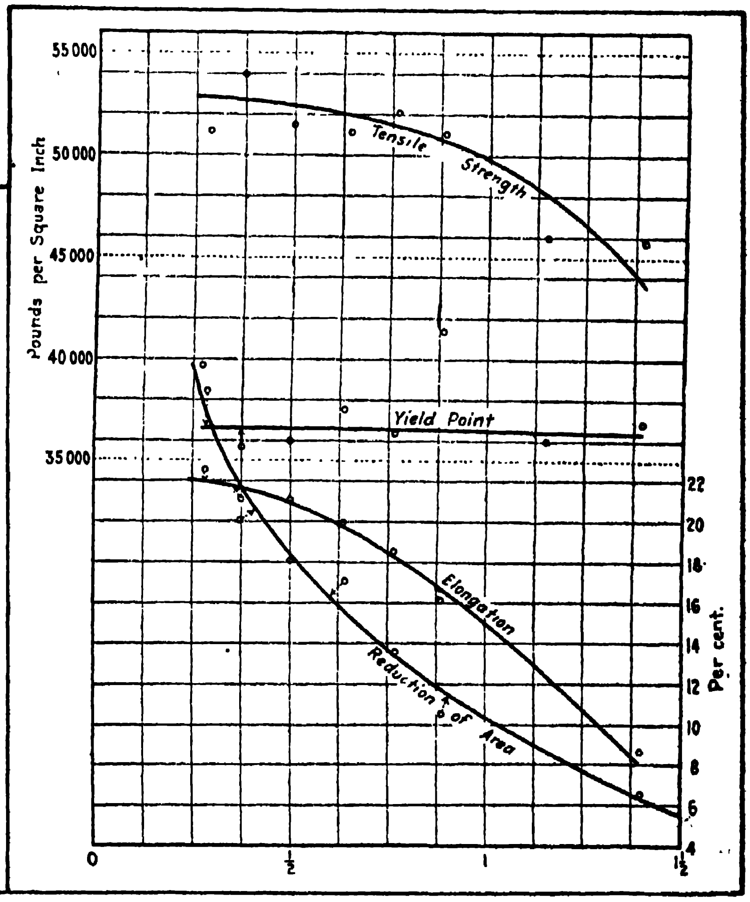


FIG. 2—RESULTS OF TESTS ON SPECIMENS GROUND BEFORE ANNEALING

For convenience in referring to these variables in the paper, they are listed and numbered below:

1 Decarbonization may strengthen the surface metal.

2 The surface metal may be stronger than that at the center, due to the effect on the grain structure of the rate of cooling in freezing.

3 Specimens of small cross-sectional area as cast may be relatively stronger from the same cause.

4 Slower cooling in the larger cross-sections may precipitate primary graphite with diastrous results.

5 The larger cross-sections may not be mechanically sound due to shrinkage. This weakens them as a whole and also weakens the center as compared with the surface.

6 The machined specimen, owing to its uniformity of cross-section, will yield apparently better results, particularly as to elongation and reduction of area, than a rough one.

A course of experiments was planned which should permit of comparisons between specimens as nearly similar in respect to five of these factors as possible in order to test the effect of the remaining variable.

It was evident early in the investigation that variable No. 5 would cause prohibitive difficulty in specimens geometrically similar to the American Society for Testing Materials specimen. Although this particular specimen is quite satisfactory in the size called for in the specifications, in sizes much larger or much smaller, as would be the case in the wide range covered in this investigation, specimens geometrically similar would not be satisfactory. Preliminary experiments were therefore conducted to determine the best design of specimen, gate and feeders to insure soundness. It was assumed that the design producing from a given metal the strongest and most ductile bars with the least variation as between triplicate specimens was that most conducive to soundness. About 3500 bars from some 500 heats were broken in the course of a preliminary investigation. As a result a set of speci-

Paper read by H. A. Schwartz at the twenty-third annual meeting of the American Society for Testing Materials in Asbury Park, N. J., June 22-25, 1920.

mens cast to the form and dimensions shown in Fig. 1 was decided upon and gated as the results of the preliminary test indicated as best. Variable No. 5 is thus eliminated from consideration.

From this pattern equipment, a number of specimens of each size were cast from metal of the following composition: Carbon, 2.44 per cent; silicon, 0.76 per cent; manganese, 0.180 per cent; phosphorus, 0.166 per cent; and sulphur, 0.099 per cent. Examination of the largest specimens disclosed the absence of graphite, thus eliminating variable No. 4. The carbon content of the metal removed by greatest possible uniformity throughout the series. After annealing, the ground specimens had, of course, increased about one per cent in diameter. The third or rough set of annealed specimens was then turned to the same diameters as the corresponding members of the series that had been ground to size. The two finished series were thus exactly similar to each other except as to the effect of the first variable. The series ground to size before annealing was exactly similar to the unmachined series, except as to the effect of the second and third variables, which are related, and some residue of the effect of the sixth vari- specimens was omitted for it was considered unsatisfactory.

The tests show clearly the decrease in strength and ductility with increasing area of cross-section and show also that decarbonization somewhat improves the material, mainly in ductility. The fact is also brought out that the surface metal, as cast, irrespective of decarbonization, is superior to the interior metal. It is further shown that these differences, though well defined, are not so great as to warrant the old assumption that malleable iron owes all its virtues to the decarbonized skin.

It can be shown that the graphs

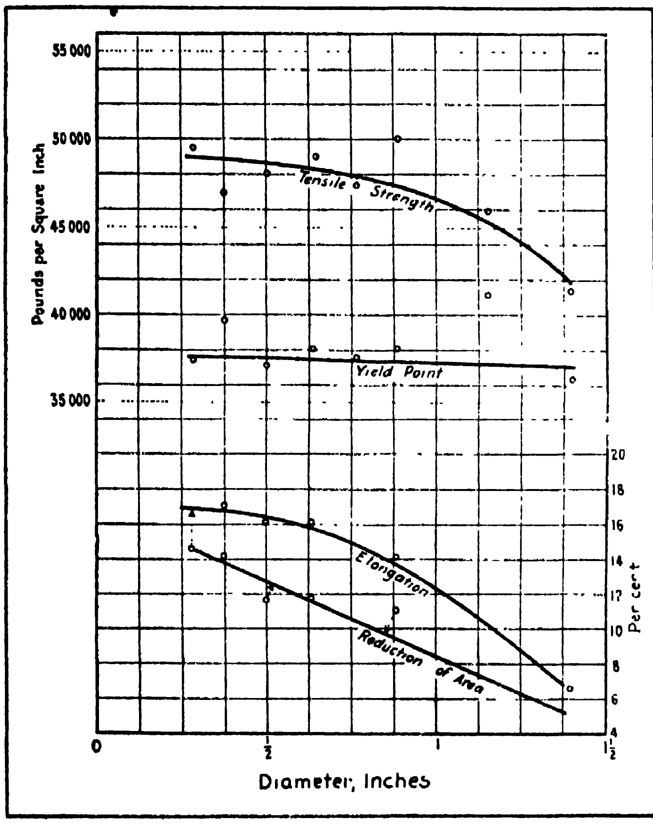


FIG. 3 RESULTS OF TESTS ON SPECIMENS TURNED AFTER ANNEALING

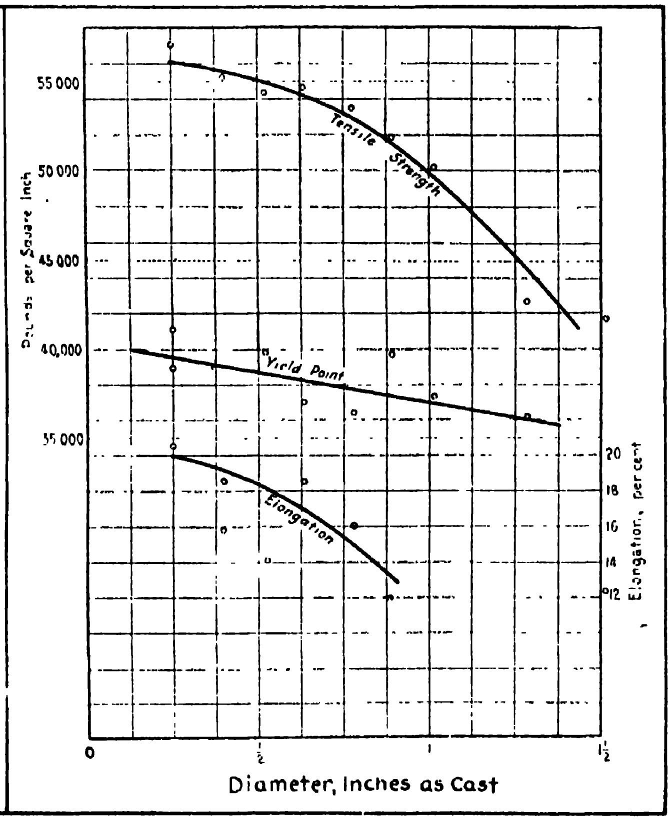


FIG. 4 RESULTS OF TESTS ON SPECIMENS NOT MACHINED

machining was determined and ran from 0.09 to 0.15 per cent.

The molds were made by a highly skilled man, so that all the specimens were unusually free from surface defects. The best one of each size was set aside for use without machining. The consequence of variable No. 6 was thus minimized as far as possible, though it of course can not be entirely overcome.

One specimen of each size was then ground for its entire gage length to a diameter 1/8-inch less than its nominal diameter as cast. This involved the removal of a little over 1/16-inch of the surface metal in most cases.

The set of specimens originally reserved, the ground set and an additional rough set were then annealed under conditions which assured the able which could not be completely overcome. Each series within itself was alike, except with respect to the third variable. An intercomparison of data from the three series should therefore permit of conclusions as to the relative effect of the first three variables.

The study of the gating problem and the production of acceptable specimens was the most difficult part of the problem, occupying about six months of experiment.

The specimens were tested in tension. The results obtained are shown graphically in Figs. 2, 3, and 4. In the absence of a suitable extensometer, the yield point was determined by the divider method; so the results are none too accurate. Determination of the reduction in area of unmachined given are nearly equivalent to the equations shown in the table on page 529 in which d is the diameter in inches of the specimen as tested.

Within the limitations of accuracy of the method used for its measurement, the yield point may be said to be nearly constant. Comparison of the reduction of area is omitted, first because the determination can not be made on cast specimens, second because the two graphs do not follow curves of similar equation, and third because the determination is not commerically applied to this product. The tensile strength of rough specimens and the elongation of specimens machined after annealing depart somewhat more from the calculated values than the other data.

The effect of decarbonization alone

on tensile properties may be obtained by subtracting equation 3 from equation 2 and is a decrease of 4000—789 d^3 pound per square inch in tensile strength and 5—.029 $d^{2\frac{1}{2}}$ per cent in elongation An attempt to compare equation 1 with equation 2 must include considerations of the fact that specimens of diameter d in equation 2 had a diameter $d + 0.125$ in equation 1. The graph for tensile strength plotted from equation 1 intersects that plotted from equation 2 at a value of d (as cast) of about 0.9 per cent. Thus, a bar annealed with its original surface is stronger than one annealed after grinding if the original diameter is less than 0.9 inches, and weaker if the diameter is greater. The variation is from 2700 pounds stronger to 3200 pounds weaker in the range investigated. The elongation

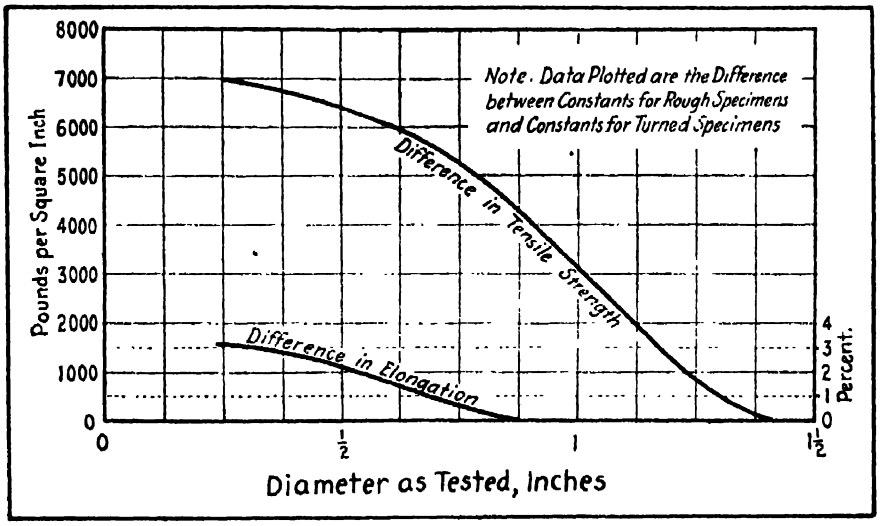


FIG. 5 COMPARISON OF TENSILE PROPERTIES OF MACHINED AND CAST SPECIMENS OF EQUAL DIAMETERS

is always less for a cast specimen, the range being from 2 per cent less at a diameter of ¼ inch to 5 per cent less at a diameter of 1 inch.

The crossing of the two graphs for tensile strength is of course due to the superimposing of two effects, that of the chilled surface which is beneficial and that of the rough surface which is harmful. The former predominates in small, the latter in large specimens.

For the use of the designer, the difference in strength and elongation of specimens cast to size and of specimens machined to the same size is summarized in Fig. 5.

The exact numerical data in the present experiment hold true, of course, only for the particular metal and heat treatment involved. Some generalizations are, however, probably justified and may lead to the following conclusions of general application:

1 Decarbonization has a favorable influence upon the strength and ductility of the product.

2 The effect of quick cooling in freezing on the surface metal of a casting is such as to improve the strength and ductility of the product

	Tensile Strength, lb. per sq. in.	Elongation in 2 in., per cent
(1) Unmachined	56,000—5,384 d^3	20—8.01 $d^{2\frac{1}{2}}$
(2) Machined before annealing..	53,000—3,231 d^3	22—6.58 $d^{2\frac{1}{2}}$
(3) Machined after annealing...	49,000—2,462 d^3	17—6.29 $d^{2\frac{1}{2}}$

3 Roughness of surface of a cast specimen apparently decreases the strength and especially the ductility.

4 The ultimate strength decreases with increasing diameter of section by an amount proportional to the cube of the diameter.

5 The elongation decreases by an amount proportional to the 2½ power of the diameter.

6 The combined effect of all three of the preceding variables on strength amounts to about 7000 pounds per square inch for sections ½ inch in diameter or less, and becomes negligible at diameters of 1¼ inch or over.

7 The combined effect on elongation is about 3 per cent for small specimens and negligible for diameters above ¾ inch.

8 The yield point is apparently not affected by any of the variables investigated.

Appoints New Secretary

W. Hollingsworth, formerly secretary of the British Society of Heating and Ventilating Engineers, has been appointed general secretary of the Institution of British Foundrymen, to fill the vacancy caused by the resignation of Capt. Alexander Hayes. The appointment was made at a meeting of the general council held in York recently and is subject to confirmation by the members.

The main office of the Institution of British Foundrymen is at Bessemer house, Adelphia, London W. C. 1, where the secretary has his headquarters.

Mat Riddell, member of the firm of Watson Gow & Co., ironfounders, Falkirk, Scotland, was nominated for the office of president by the general council at the same meeting. The election will take place at the annual convention which will be held at Glasgow Aug. 27, 28 and 29.

The Institution of British Foundrymen has been granted a royal charter which it is hoped will be completed in time for the meeting in August. The steady growth of the society continues and the membership approaches 2000.

Acquires Ring Plant

The Detroit Piston Ring Co. has purchased the Plymouth, Mich., plant of the National Foundry & Machine Co., Ypsilanti, Mich, and will operate under the name of the Detroit Ring Casting Co, Plymouth, Mich. The foundry will employ 40 molders, specializing on rings which will be machined at the main plant, Detroit.

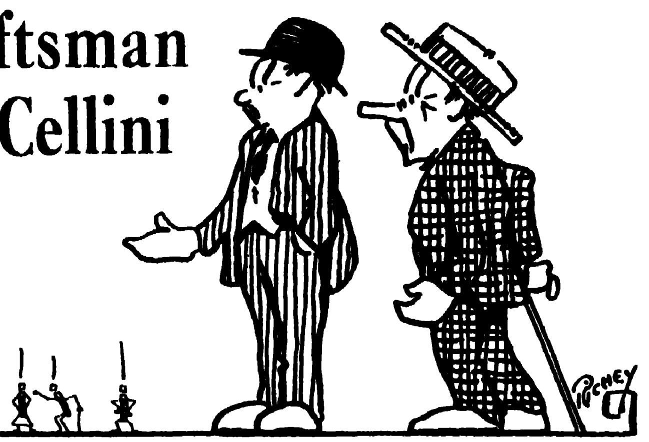
Consolidates Interests

The Gillespie Mfg. Co., Gillespie Motor Co., Broker-Eden Co. and the Gillespie Foundry Co. have consolidated under the name of the Gillespie Eden Corp. to produce washing machines and all the component parts required. The officers are T. H. Gillespie, president; F. J. Nash, secretary, and H. S. Hart, treasurer.

The Racine Furnace & Foundry Co., Racine, Wis., recently has been formed from a reorganization of the Osborne Casting Co., of that city. Capital stock of the company has been increased to $60,000. The officers of the company are Charles G. Holmes, president; John H. Osborne, vice president, and William F. Stremke, secretary.

The Lycoming Foundry & Machine Co., Williamsport, Pa., has changed its name to the Lycoming Motors Corp. and under this designation will continue the manufacture of automobile motors.

Bill Admires That Master Craftsman Benvenuto Cellini



BY FAT DWYER

IF WE were to believe all we hear, which indeed would be a calamity, we could trace all our actions and physical characteristics to hereditary influence. Some learned authorities claim that we inherit everything from the color of eyes to wooden legs from our ancestors. Other equally learned and spectacled gentlemen are inclined to hedge a little and hesitate to give their unqualified approval to such items as peg legs, false teeth and glass eyes. They never hesitate to rush into print on the slightest provocation, airing their views on the subject. In justice to these learned savants it must be admitted that they are wise in their generation and always preface their remarks by one of the two standard phrases which are always left standing in all well regulated newspaper offices: "It is claimed on competent authority," or "It has been stated by those in a position to know."

I have always been inclined to doubt the hereditary theory. None of my ancestors, so far as I have been able to gather from a diligent perusal of *Burke's Peerage* or *Who's Who* to say nothing of that other standard work *Vich is Vich*, ever so much as saw the inside of a foundry. Yet I drifted into the business at a tender age and absorbed foundry lore, plumbago dust and sulphur fumes from open salamanders as naturally as if my remote ancestors had been accustomed to grubbing castings out of the sand every morning instead of wearing the hair off their toes grubbing potatoes out of the soil of the "Old Sod."

The clinching and final point against heredity lies in the question of clothes. When I was a little boy I used to get a new suit ever so often—not to be too specific. Now that those days have gone by and I am become, thanks to my foundry training, indifferent to the opinion of others on the subject of clothes, I don't mind admitting that I then had a gentle, bashful and retiring disposition. I suffered agonies on the first few occasions on which I wore a new suit, even from the comments of friendly disposed acquaintances who commented on the quality, style and price of the apparel. I would take a round-about way to church and school. When I approached them in the morning or my own house at night I would scuttle in at the door like a rabbit.

Now if there was anything in this heredity theory, bashfulness and a retiring disposition should be a prominent characteristic in my children. But is it? It is not! When they get new clothes they do not care who knows it. The novelty of being decked out in new and shining raiment may have some bearing on the question but I think that evidence may properly be ruled out as being irrelevant to the subject at issue. One lusty young hero who is 5 years old and therefore in a position to form his own opinion on nearly any subject found himself trimmed up last Sunday in a new suit which included braces and pockets in the pants. Our immediate neighborhood was too restricted an area to do justice to such magnificence and he suggested that I would be conferring a favor on mankind in general if I should take him for a stroll in the park. I assured him that nothing would give me greater pleasure than to accompany him and shine to a limited extent in his reflected glory.

We strolled in the park for awhile and then sat on one of the steps of the art museum in the vicinity of Rodin's bronze statue, The Thinker, a gentleman who as you know wears no clothes. I was idly speculating on what he probably was thinking about, when Bill came down the steps and took a seat along side us. I asked his opinion of what our bronze friend was turning over in his mind. Bill said that probably he was congratulating himself that he did not have to shoot his whole pay check every month for enough clothes to pass muster with the rest of the Willies.

"'Tis a fine piece of work, though," said he. "Do you know whenever I see one of these big statues I regret that I never had the opportunity of working in one of those old European foundries where they made that kind of castings. A short time ago I read the biography of one of the most famous of the old birds connected with the foundry industry, Benvenuto Cellini and, say, he certainly was a master craftsman. The book, of course, was a translation from the Italian and I am afraid the translator had a better knowledge of the Italian language than he had of foundry practice. He gives several of Benvenuto's questionable exploits as a bravo and gay Lothario with the minutest detail but in translating the artist's description of how he prepared the molds, melted the metal and poured the castings for some of his famous statues, for the most part he is delightfully vague and only mentions the points which would be apparent to the most casual observer. The multitude of little intimate, practical details which would appeal to men familiar with foundry practice are sadly lacking.

In only one instance does the volume treat in detail of any specific job and then the description is confined mostly to the trouble our hero experienced in melting the metal for a large figure which he had molded and then buried in the floor. From the meager details available it appears that he employed the *lost wax* process, a process by the way which is still employed extensively among manufacturers of statuary and ornamental bronze castings."

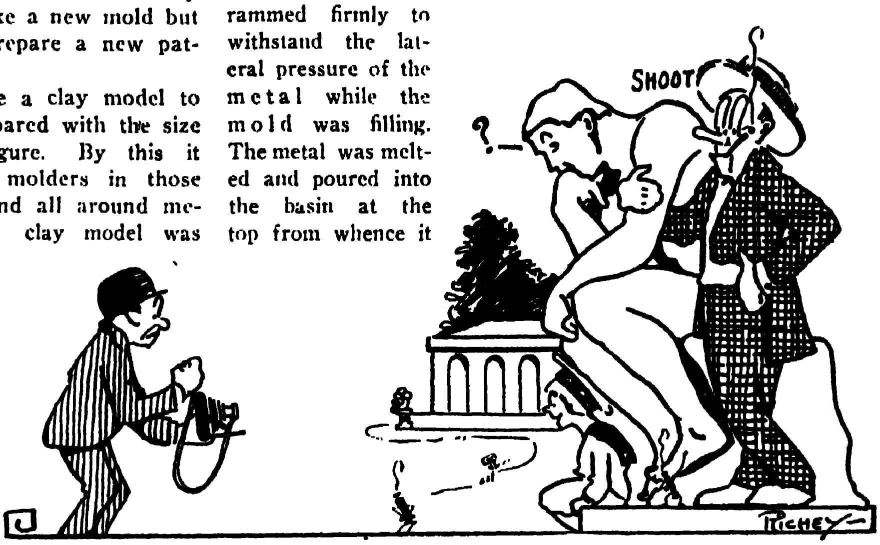
"I know all about it," I said. "I read a description of the process in THE FOUNDRY."

"I remember reading the same story you are talking about," said he. "The

illustration showed a model of a Rocky mountain sheep or a billy goat being used for a pattern. In that method you are talking about, they make a master mold out of plaster of paris and then make as many duplicates off it as are necessary. In Benvenuto's time they only made one mold and therefore if anything went wrong with the casting process it meant that they not only had to make a new mold but they also had to prepare a new pattern.

"Cellini first made a clay model to a certain scale compared with the size of the proposed figure. By this it will be seen that molders in those days were artists and all around mechanics. After the clay model was finished he welded together several pieces of bar iron to serve as a core iron. The core iron was set up on a foundation in a pit in the foundry floor and a rough core core built up bricks and loam conforming to the contour of the proposed figure. A thickness of wax equal to the desired thickness of metal was then built on the core, the outside surface of the wax being modeled to form a replica on an enlarged scale of the small clay model.

"Commencing at the bottom a thin coating of fine slurry was painted on to the wax, a coating of loam laid next to that and then a wall of brick behind that. The building was gradually carried up until the entire figure was enclosed. Wax sticks were attached at various points and carried up through the brick work all converging at the top into a common basin which was destined to receive the metal. An opening was left under the bottom communicating with the interior of the hollow core and after the mold was completed a charcoal fire was built in the opening and another fire built around the outside and both of them kept going until all the wax had melted and run out and the mold was thoroughly dried. The opening at the bottom and the pit surrounding the mold was filled with sand and rammed firmly to withstand the lateral pressure of the metal while the mold was filling. The metal was melted and poured into the basin at the top from whence it

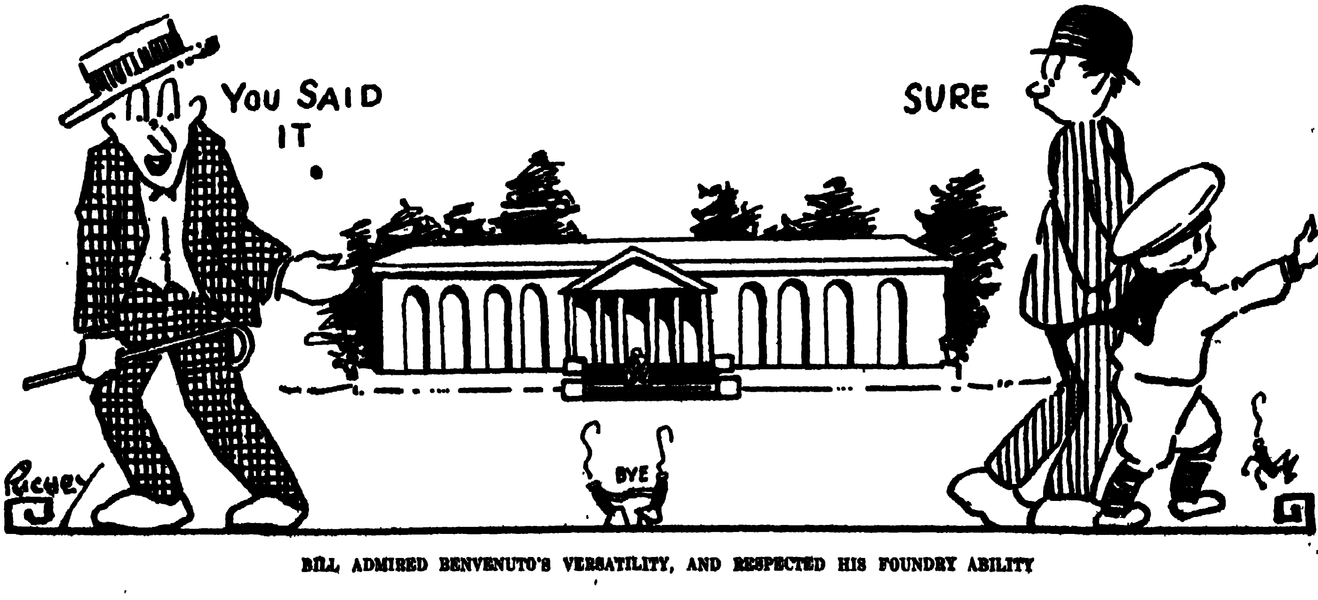


BILL IN CLOSE PROXIMITY TO REAL THOUGHT

was conveyed and distributed to the different parts of the mold through the channels left by the wax sticks.

"There was no law against overtime in those days and Ben had worked night and day on the job, with the result that by the time the mold was finished he had a high fever and was all in. He superintended charging the furnace and then went to lie down, leaving orders to be called as soon as the metal was melted. While he slept a terrific wind and rain storm arose which lifted the roof off the furnace room. The helpers sheltered themselves as best they could and neglected the fire and the metal which almost had been ready, commenced to set. His faithful old landlady aroused Ben and told him if he didn't get on the job all of his work would be ruined. Did that cure his fever? I'll say it did. He came into the foundry in two jumps raving and roaring like some of his modern prototypes, but with greater cause, and he certainly got action. He sent for all the pewter dishes in the house and threw them into the pot. He sent some of his men across the street to a bake shop where they grabbed a quantity of dry oak wood. He started a fire under the grate of his furnace, piled all the dry oak wood in it and succeeded in getting his metal liquified again. It was not in as perfect condition as he would have liked to have seen it, in fact a considerable portion was stuck to the sides of the pot. However, he took a chance, the same as molders always did and always will, and poured the casting. There was not a drop left in the basin and he was afraid he had poured the casting short but when the casting was stripped it was found to be perfect with the exception of one little place down near the bottom where the metal had been too dull to run.

"Old Ben had one characteristic which shows that molders were the same in those days as they are now. He never admitted that he lost a casting. In the case I have mentioned he admits that he *nearly* lost this one, but as a further proof of the analogy between ancient and mod-



BILL ADMIRED BENVENUTO'S VERSATILITY, AND RESPECTED HIS FOUNDRY ABILITY

ern foundry practice, he is right there with the alibi and places the blame on the furnace tender. The circumstance afforded him an opportunity to show his resourcefulness by burning a piece onto the defective part afterward and he gives this feature due prominence. Taking it by and large I think you will have to admit that the Ancient and Honorable Art shows no sign of decadence and that modern foundrymen are ably upholding the noblest traditions of the craft.

"When I read that story it carried me back a good many years to a shop I worked in where an occasional pot of brass was melted in the blacksmith forge. The molds were made in the foundry and carried to the blacksmith shop on a flat hand barrow. The pot was placed in one of the forge fires and charged with metal. Some one had to stand alongside for an hour or more and keep the coal fire built up. A second man was kept busy carrying slabs of wood to make an additional fire around and over the top of the pot. It was an expensive method but the castings were as sound and solid as any I have seen made by any process since."

"If you would kindly give me a chance to say a word," I said, "I might say that I also have read Benvenuto Cellini's biography and the only wonder to me is how he found time in the midst of his fights and his amours to make any castings at all."

"You said it," said Bill.

One-Piece Coreboxes Find Ready Favor

BY M. E. DUGGAN

CORES are projecting forms of sand, either left in the mold by the pattern itself and known as green sand cores, or made separately in a corebox and known as dry sand cores. The latter are dried before being placed in position in the mold. A dry sand core is employed to produce a hole or recess of a peculiar shape or in a position where it is impracticable to make the mold of the necessary conformation by the use of the pattern alone. Dry sand cores frequently are employed to modify the shape of a pattern to simplify the molding process.

Dry sand cores are composed of sand, bonded artificially and rammed in coreboxes to form the desired shape. After these cores have been baked they are strong enough to withstand considerable rough handling; but previous to baking they are so weak that they cannot be handled without being supported in some way. It therefore is as necessary for the patternmaker to know how the corebox is to be taken off the core as it is for him to know how the pattern is to be drawn out of the mold.

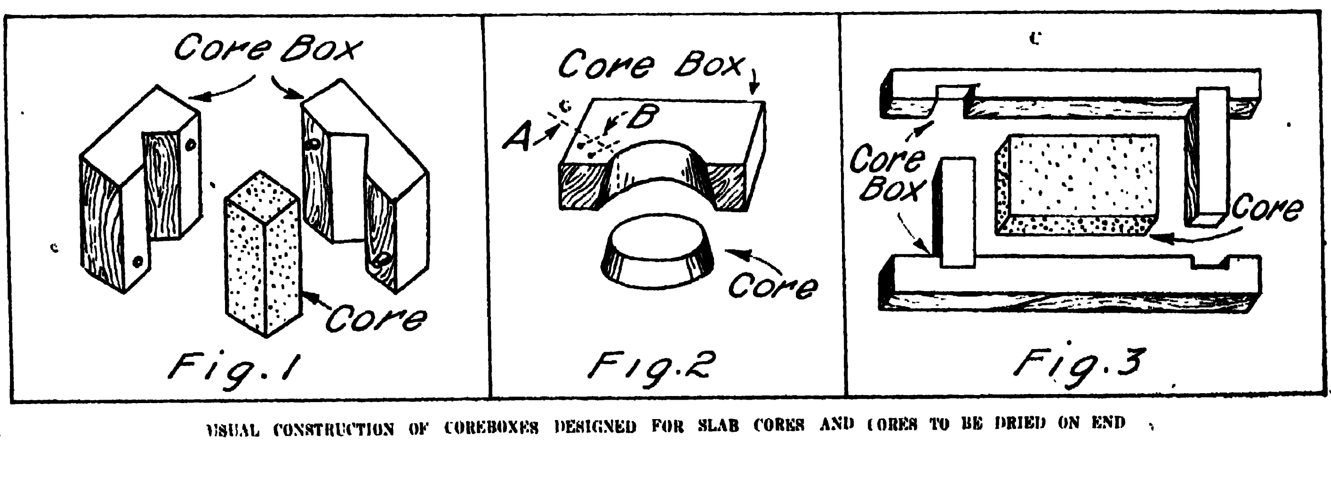
The coreboxes shown in the illustration are examples of the method usually employed. The corebox shown in Fig. 1 is made in halves and that in Fig. 3 is loose at two opposite corners. These boxes can be drawn away horizontally from the cores leaving them standing just as they were made, on an iron plate, ready for removal to the core oven.

The question often is raised. When does the method shown in Fig. 1 cease to be practical? In other words what is the greatest length of 2-inch square core that can be dried on end? I have asked this question of many patternmakers and received practically a different answer each time. No one seems to have any definite idea on the subject. How is a patternmaker to know the greatest length of core in proportion to its diameter or square that can be dried on end. For example if 6 inches is the limit of a certain diameter core for drying on end, it simply is wasting time and material for the patternmaker to make two half boxes for cores over that length.

A common method of constructing slab coreboxes is shown in Fig. 3. It is made loose at the opposite corners, is provided with checked-in joints and is designed to be taken apart before removal from the completed core. I was taught to make coreboxes as illustrated in Fig. 3 whether for cores $\frac{1}{4}$ inch deep or for cores 10 inches deep and whether one or many cores were wanted.

When these coreboxes reached the core room the coremaker invariably made one-piece coreboxes out of them by nailing the corners together. Instead of drawing the box away horizontally in two halves he drew it straight up in one piece. I learned from this that much of the work lavished on this style of corebox is unnecessary. Since learning that the one-piece corebox is practical and preferred by the coremaker I have made hundreds of them.

The usual way to make a corebox like that illustrated in Fig. 2 is to turn it out on the lathe from a solid block. In my early days at the trade I made coreboxes in that manner. However, I learned later that coreboxes of this and many other designs can be cut on the bandsaw in about one-fourth the time required to make a turned box. The piece is dressed to the required thickness, the circle struck on the face of the block, the saw table tilted to the required angle, a saw cut made on the line *A* and the center cut out to the required size. With a little sand-papering the job is finished. The joint *A* where the saw entered and came out can be drawn together and fastened with a few nails as at *B*, in Fig. 2



USUAL CONSTRUCTION OF COREBOXES DESIGNED FOR SLAB CORES AND CORES TO BE DRIED ON END

Fitting the Foundry to the Product

Established Machinery Manufacturing Company Draws From Its Past Experience in Building and Equipping New Addition For Castings Production

BY PAT DWYER

TODAY the tendency among manufacturers is to specialize as far as possible, to concentrate on one particular product, and by a system of intensive methods, scientifically applied, to secure a maximum output with a minimum expenditure of labor and expense. To secure this result it usually is found necessary to install special mechanical equipment and arrange the sequence of operations peculiar to the process so that the complete operation can be finished with the least number of motions and provide that each time the article in course of construction is worked upon it is passed along a little further toward its ultimate goal. A considerable amount of machinery is manufactured by the machine tool builders for fabricating different materials on fairly well established standard lines. The precision and accuracy of operation maintained by these machines when in use insure a large output of high grade product and incidentally reflect credit on the manufacturer who made them.

Nearly all of the firms engaged in the manufacture of power tools carry a large list of stock sizes and designs of patterns from which they are prepared to furnish machines and in addition many of them maintain a staff of engineers familiar with their particular problems who are willing and competent to design special machinery to perform almost any duty that a customer may specify.

The builders of this special machinery are placed in the rather peculiar position that while their machines enable customers to standardize for larger production, they themselves must treat each machine as a unit and proceed with its manufacture along more or less untried lines. This factor to a great extent eliminates the possibility of quantity production because many of the machines are ordered singly or in small lots of two or three units and may never be duplicated. Even in cases where the order is duplicated it is nothing uncommon to find it accompanied by instructions to make certain changes which in the great majority of cases makes it practically a new job.

Owing to these and, perhaps, other reasons, the firms engaged in special machinery work have been slow in modernizing the building and equipment in their foundry department. The great bulk of the work made in their foundries requires the services of highly skilled men and of course the principal advancement made in foundry

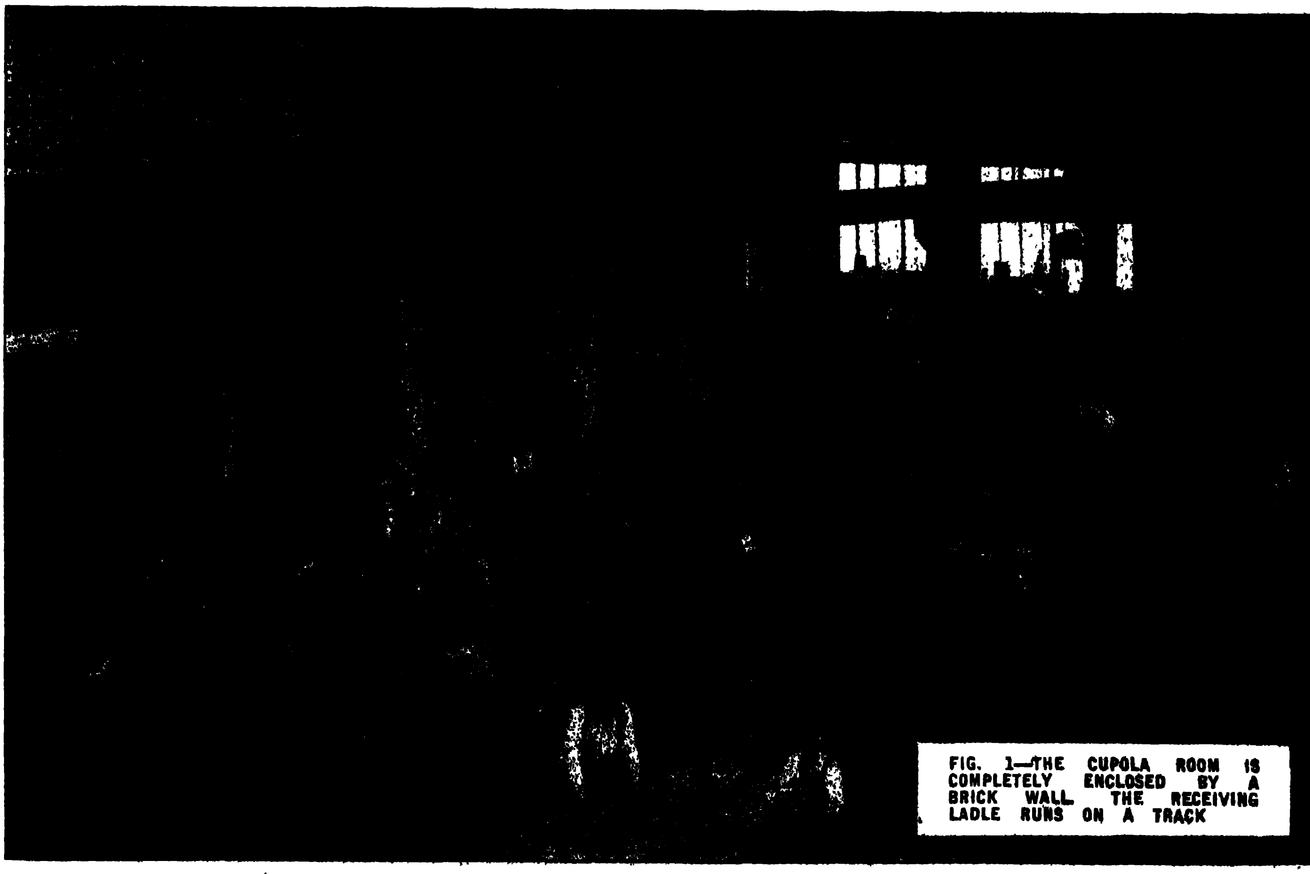


FIG. 1—THE CUPOLA ROOM IS COMPLETELY ENCLOSED BY A BRICK WALL. THE RECEIVING LADLE RUNS ON A TRACK

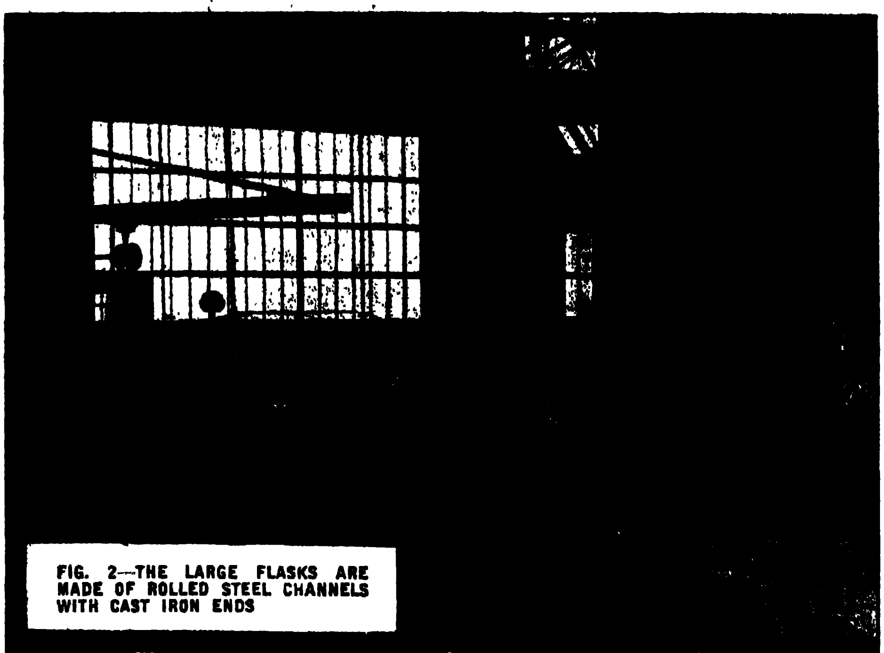


FIG. 2—THE LARGE FLASKS ARE MADE OF ROLLED STEEL CHANNELS WITH CAST IRON ENDS

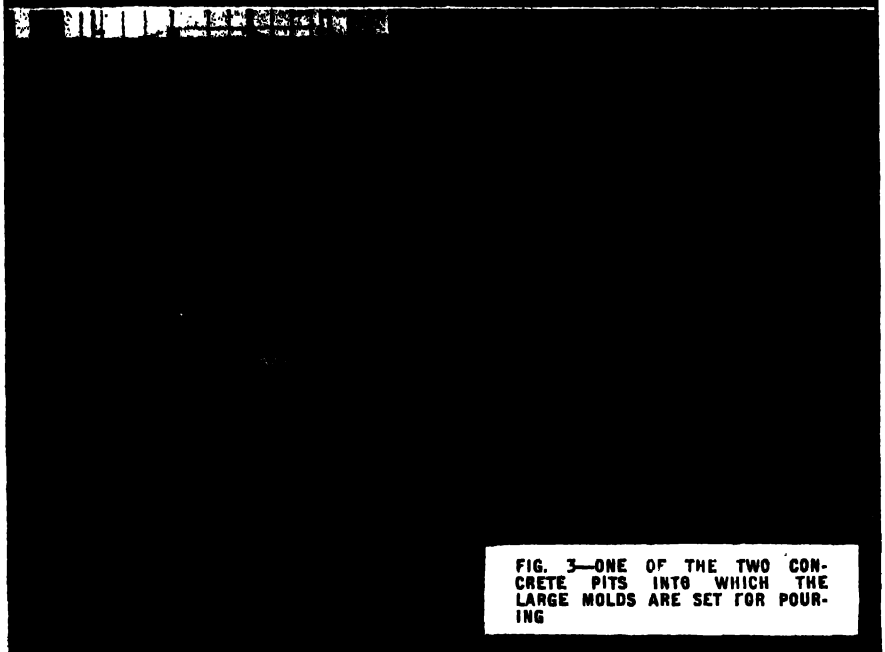


FIG. 3—ONE OF THE TWO CONCRETE PITS INTO WHICH THE LARGE MOLDS ARE SET FOR POURING

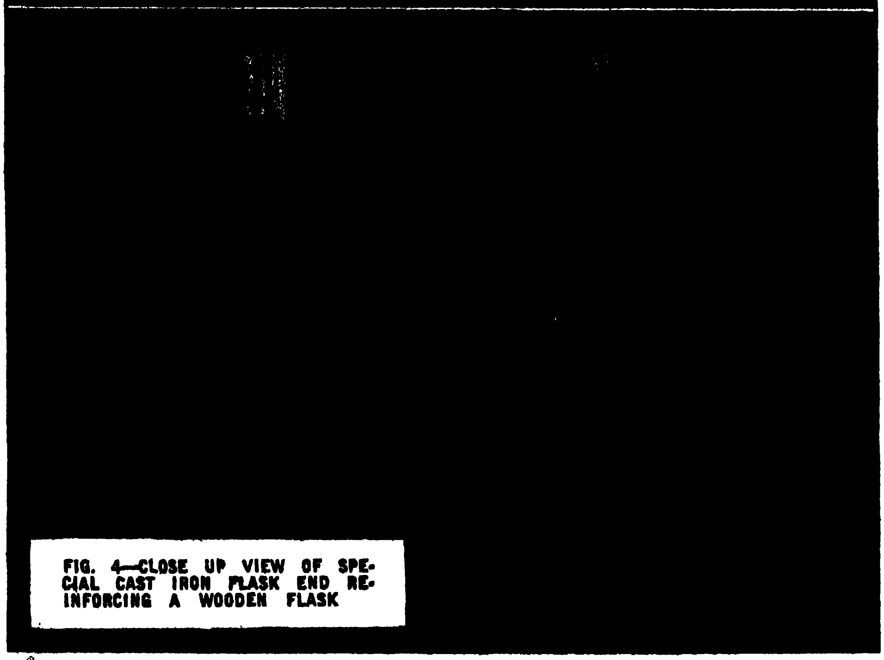


FIG. 4—CLOSE UP VIEW OF SPECIAL CAST IRON FLASK END REINFORCING A WOODEN FLASK

practice in recent years has been in devising methods to secure increased production on repetition parts with unskilled labor. The cost of installing the necessary equipment for doing that kind of work is quickly absorbed in the immense production but is entirely out of the question in a shop where the machines are ordered in units and not in thousands. However, there are some phases of the foundry problem, such as light, heating and ventilation which are common to every foundry and the improvements effected in these features in recent years may be applied with equal facility to any business devoted to the casting of metals.

A new foundry designed by and erected under the supervision of Clement A. Hardy, Chicago, recently has been placed in operation at the plant of the Defiance Machine Works, Defiance, O. The peculiar conditions incident to the manufacture of the company's product, consisting to a great extent of special wood and metal working machine tools, were taken into careful consideration when designing the building and installing the equipment. The present output is about 10 tons a day, but to allow for future increase the plant was built to function satisfactorily up to 20 tons. The building is 132 x 140 feet and as may be seen by the illustrations, consists mainly of windows outside of the end walls and the roof Most of the sash sections are top hung and may be adjusted to promote circulation of air and help to keep the shop cool in the summer. It is heated in winter by a continuous system of steam radiators which extend around the wall at the floor level and a supplementary row high up near the peaks at the two sides of the Pond-truss roof.

General Shop Layout

The entire floor of the building with the exception of two casting pits near one end of the main bay is covered with a smooth concrete floor. All the molds made in this shop are made in flasks and rolled over and the smooth, level concrete floor is a factor in preventing the molds from warping and producing crooked castings. The building is divided naturally into three bays by the two rows of columns supporting the crane runway and the roof. The center bay is 52 feet wide and each of the side bays is 44 feet. The center bay is devoted entirely to molding and cleaning the large castings. One of the side bays contains molding floors and the chipping and grinding room while the other side bay covers the

FORMULAS FOR THE BRASS FOUNDRYMAN

ALUMINUM ALLOYS PATENTED IN THE UNITED STATES AND ABROAD

The following alloy was patented by W. A. McAdams, United States patent No. 1095653:

	Per Cent
Aluminum	70.00
Zinc	22.00
Antimony	5.00
Copper	3.00

The object in adding antimony was doubtless to control the shrinkage of the alloy.

The following alloy was patented by C. P. Van Gundy, United States patent No. 1098137:

	Per Cent
Aluminum	86.50
Zinc	9.70
Lead	2.50
Copper	1.30

The object gained by addition of lead is a closer grained alloy that will resist pressures.

The following alloy, patented by W. A. McAdams, United States patent No. 1104369, is claimed to be suitable for "hammered silverware":

	Per Cent
Aluminum	80.00
Silver	4.00
Tin	8.00
Cadmium	8.00

As manganese is frequently used in making alloys of aluminum it is interesting to note, this has been made the subject of a patent by Alfred Wilm, Berlin, Germany, United States patent No. 1130785, March 9, 1915.

The inventor states the addition of manganese is particularly advantageous when it also contains up to 2 per cent magnesium. As an example the following alloy is given:

	Per Cent
Aluminum	93.10 to 96.50
Magnesium	0.5
Copper	5.6 to 3.00

This alloy has certain properties, but the addition of as little as 0.5 per cent manganese, increases the strength about 17 per cent, the hardness, by the ball test, about 10 per cent, and at the same time the alloy is better to file and work.

FORMULAS FOR THE BRASS FOUNDRYMAN

ALUMINUM ALLOYS PATENTED IN THE UNITED STATES AND ABROAD

An alloy that is claimed to be particularly adapted to casting purposes is the subject of a patent by W. A. McAdams, United States patent No. 1146185. The following proportions are suggested:

	Per Cent
Aluminum	82.00
Copper	12.00
Cadmium	5.00
Silver	1.00

In United States patent No. 1156093, Charles Pack protects alloys of aluminum adapted for die-casting purposes. Two alloys are suggested as follows:

For small, simple castings:

	Per Cent
Aluminum	91.00
Copper	9.00

The inventor finds it desirable and necessary to increase the percentage of copper as the castings increase in size and become more complicated. The highest percentage of copper he has been able to use successfully, follows:

	Per Cent
Aluminum	80.00
Copper	20.00

The addition of iron to aluminum alloys also is suggested by A. W. Morris in United States patent No. 1227174. The inventor claims the presence of iron operates to reduce the shrinkage of the castings or forgings, thus overcoming the danger of cracking. The iron, it is claimed, also increases the density of the castings and the tensile strength and elongation. The iron can be added to any alloy of aluminum, but its aluminum content should not be under 70 per cent.

The percentage of iron should not be less than 1 per cent, or more than 6 per cent, and the silicon content of the alloy should be kept low.

A combination of aluminum and beryllium has also been patented by H. S. Cooper, United States patent No. 1254987. It is claimed the alloy produced by melting together the two metals is greatly superior to aluminum alone, and also of lower specific gravity.

coremaking and drying department and the cupolas.

The center bay is spanned by a 10-ton electric traveling crane made by the Whiting Foundry Equipment Co., Harvey, Ill. Additional hoisting equipment is provided by three column jib cranes supplied by the same company; each one equipped with a Yale & Towne 1-ton chain block. Two of these cranes are situated opposite each other so that one crane swings past the end of one casting pit and the second crane swings past the other. These cranes are employed in many ways but their principal purpose is for handling auxiliary ladles of iron when pouring long castings or castings which are too heavy to pour with one ladle.

The casting pits are concrete and each is 4 x 8 x 15 feet. Five steel rings equally spaced are anchored in the bottom along each side. They are used for attaching the ends of the long bolts employed for binding the molds together before they are poured. The type of flask used on this class of work is clearly shown in Fig. 3. The sides are rolled channel steel sections as shown in Fig. 2 and heavy wooden planks as in Fig 4. The end plates in both cases are heavy ribbed cast iron and combine the functions of end plate and clamp. The style of handles used for handling the flasks is clearly indicated in Figs. 2 and 3, and the method of affixing the guides for locating the cope is shown in Fig. 3.

Molding Methods

The mold shown in the illustration, Fig. 3, approximately 13 feet long, is for the body of a multiple double-end horizontal drill. The steel drag is not deep enough so a heavy plank frame is built and attached as an upset. A number of bolts are employed to hold the wooden drag together at the ends and in addition several bolts extend from side to side at various points between the ends. On account of the shape of the casting it is manifestly impossible to run any bolts through the sides where they are needed most and therefore it is customary to drive blocks and wedges between the sides of the drag and the wall of the pit to prevent the flask and mold from straining under the pressure of the molten metal.

The pattern for this and similar jobs is split longitudinally down the center. One half is placed on a flat board, a drag set on, filled with sand, rammed and rolled over, after which the drag is lowered into the pit. Under ordinary circumstances the joint of the pattern is kept flush with the joint of the flask but sometimes as in the present instance, on account of the cope not being deep enough to accommodate the cope half of the pattern it was necessary to keep the parting line of the pattern about 6 inches below the joint of the drag. The deep lifts at each end are taken care of by casting light open sand plates corresponding to the shape of the parting at the end of the pattern. These plates are provided with two screw bolts long enough to reach beyond the top surface of the cope. These plates are set on the parting before the cope is lowered into place. Sand afterward is rammed over them in the usual way with the exception that no gaggers or soldiers are needed. When the cope has been rammed to the top, the bolts on these plates are tightened with nuts and washers and are a positive assurance that the pockets will lift when the cope does and furthermore that the pockets will not drop.

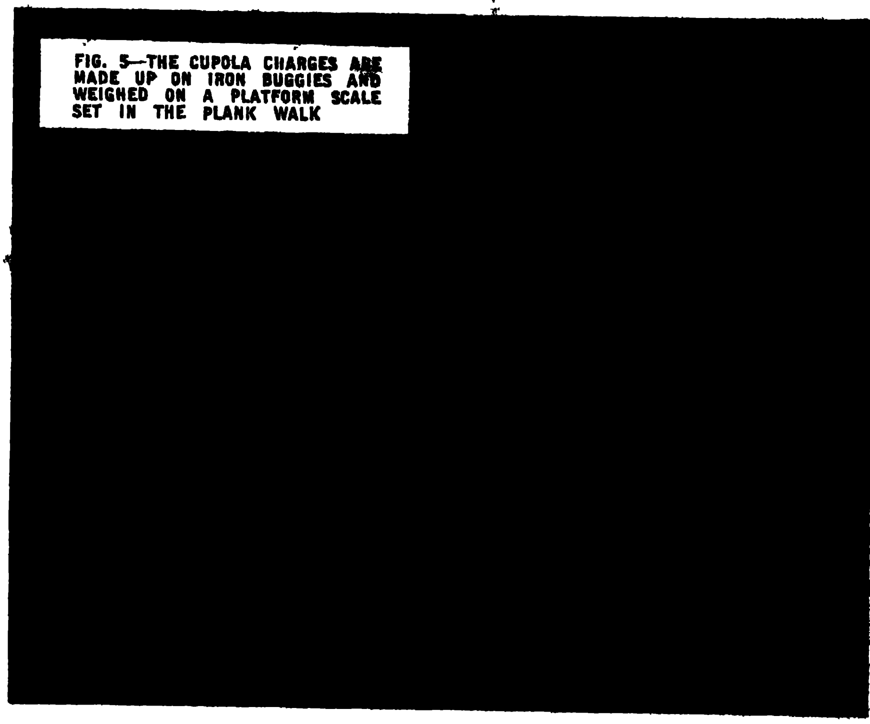


FIG. 5—THE CUPOLA CHARGES ARE MADE UP ON IRON BUGGIES AND WEIGHED ON A PLATFORM SCALE SET IN THE PLANK WALK

The copes on these large jobs are not rolled over to enable the molder to finish and repair the face of the mold. Piers composed of short wooden blocks are built up at each of the four corners to a sufficient height to allow the molder to work comfortably underneath. The piers are built to an approximate height and then the cope is lowered until it touches on the highest. It is held there by the crane until the remaining three piers have been built to the same height. Wedges are inserted between the flange of the cope and the top blocks on the piers and then the crane releases the load. Great care is necessary in building these piers and adjusting the cope so that the load is evenly distributed, otherwise it is likely to slip after the crane has been removed, with disastrous consequences to whoever happens to be working underneath. The solid concrete floor is much better adapted for securing a firm foundation for piers built up in this way than the ordinary sand floor with its many and uncertain hard and soft spots.

None of the molds is skin dried but the larger ones are surface nailed extensively and poured from the bottom through gate cores. Delicate projecting bodies of sand frequently are taken care of by fitting dry sand cores into the pattern and ramming them with the rest of the mold. Local sand is used for making the molds. After the pattern is drawn the face of the mold is nailed, tooled and finished and then given a coating of plumbago which is brushed and rubbed on by hand. Some of the castings are quite large, requiring flasks 6 x 15 feet, but the metal section in nearly all cases is quite light, usually not over ¾-inch. Since many of them afterward are machined on the cope side as well as the bottom and both ends it follows that the molding, melting and casting processes must be carried out with a considerable degree of skill.

A great number of the employes have been with the company for many years. Records of 25 and 30 years are not uncommon. A few men have worked here for 50 years and there is at least one man with a record of 55 years to his credit. The com-

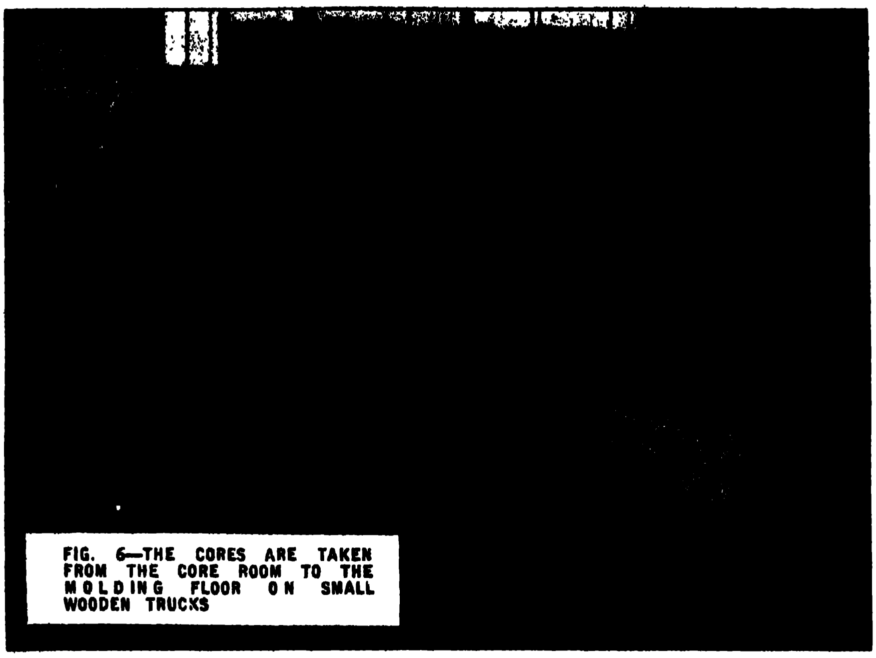


FIG. 6—THE CORES ARE TAKEN FROM THE CORE ROOM TO THE MOLDING FLOOR ON SMALL WOODEN TRUCKS

pany's plant is the main industry of the town, employing as it does nearly 1000 men in the various departments, and it is only natural that the sons of the older men as they grow up enter the office and shops where their fathers have been working, some of them all their lives. This digression is pertinent at this point because the circumstances outlined exert an undoubted influence on the character of the work turned out. It also furnishes an interesting sidelight on the policy and aims of a company. Many of these veterans still are hale and hearty and go through their allotted day's work with as much apparent ease as men many years their junior. However, a few are delegated to keep the shops clean and tidy. For this purpose they are much more satisfactory than younger men. They take their duties seriously and do not have to be either watched or driven. It is true they do not work rapidly, but there are enough of them to cover the ground comfortably and as a result the shop always looks as if it had just gone through a thorough cleaning.

Use Battery Trucks

The heavy castings are taken by the crane directly from where they are poured and set on the floor near one end of the shop. Here they are chipped and cleaned, any necessary grinding being done by pneumatic flexible shaft grinders made by the Chicago Pneumatic Tool Co., Chicago. After they are cleaned, they are loaded on electric lift trucks and hauled into the machine shop. Several of these trucks are employed around the plant, some made by the Cowan Truck Co, Holyoke, Mass., and the others by the Elwell Parker Co., Cleveland. Their use is greatly facilitated by paved and concrete floors in all departments and concrete roads in the yard connecting the different shops.

The small casting molding floor occupies all the space in one of the side bays with the exception of a space 40 x 40 feet at one end which is used for a cleaning room. The molding floor is spanned by a hand controlled, 3-ton, electric traveling crane made by the Whiting Foundry Equipment Co., Harvey, Ill. The cleaning room is enclosed by a hollow-tile wall and is equipped with the usual appliances for cleaning small castings. The mechanical cleaning equipment was supplied by the W. W. Sly Co., Cleveland, and includes two large and two small tumbling barrels. They are provided with wire screen guards in front and also with individual cranes for handling the doors. The entire battery is driven from one shaft which in turn is actuated by a 20-horsepower Westinghouse motor. A dust arrester exhausts all the dust and dirt from the tumbling barrels while they are in motion. Two double grinding wheel stands driven by a 15-horsepower Westinghouse motor were supplied by the Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn. They are located in one corner of the cleaning room. The small castings are carried into the cleaning room by wheelbarrows and lift trucks. After tumbling in the barrels for a certain length of time they are taken out and the necessary chipping done on two long benches which parallel each other nearly the full length of the room. These benches are equipped with a number of vises for holding the work. A drawer in the bench in the vicinity of each vise serves for holding the chisels, files and other tools used by the men who work in this room. The castings from the cleaning room also are loaded on lift trucks and transported to the machine shop in the same manner as the large castings previously mentioned.

Flour Used for Binder

In the second side bay are the coremaking and drying departments, the cupolas, blower, charging room and elevator, the mold drying ovens which are never used for that purpose, the locker and wash room, the pulley and hanger molding floor, and the brass shop.

Michigan City sharp sand is used exclusively for all the cores. For the smaller shapes and stock cores it is

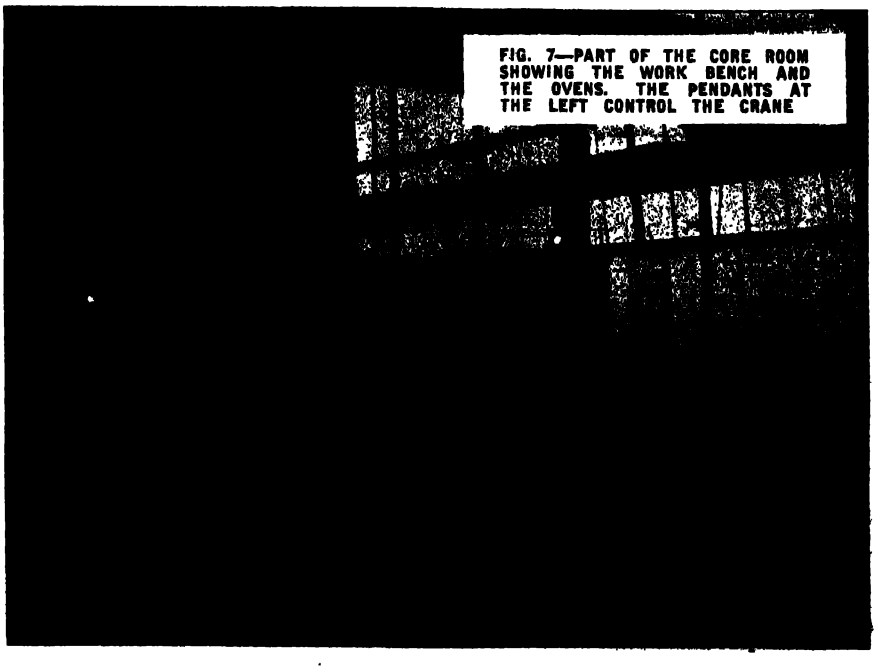


FIG. 7—PART OF THE CORE ROOM SHOWING THE WORK BENCH AND THE OVENS. THE PENDANTS AT THE LEFT CONTROL THE CRANE

used in a practically pure state mixed with an oil binder, while in the larger cores a certain proportion of clay, dug on the company's property, is added in varying amounts of from 10 to 20 per cent, depending on the bulk of the core and other governing factors. Flour is used for a binder in all the large cores. This is not the rich, sticky, glutinous flour used so commonly in the foundries a few years ago, but still flour of a kind. In fact, it is a mooted question if this so-called inferior flour is not superior to the regular article for this particular purpose. It is true a larger quantity is required to bond a given amount of sand but this feature is offset by the fact that it burns out more readily and therefore offers less resistance to the natural contraction of the casting. This is an important factor in the production of long castings having only a light metal thickness. A core which is too stiff through using a strong binder interferes with the contraction sufficiently to throw certain portions of the casting out of their calculated position. In extreme cases this will result in rupture of the casting at one or more points. Rods, bars and pieces of pipe are used exclusively for reinforcing the cores. The custom prevalent in the majority of shops of using cast iron core arbors is not practiced here.

Core Room Well Equipped

The core room is spanned by a 3-ton electric traveling crane made by the Whiting Foundry Equipment Co., Harvey, Ill., and operated from the floor by a number of pendant controls similar to the crane on the side molding floor. The sand for the cores is mixed in a revolving machine

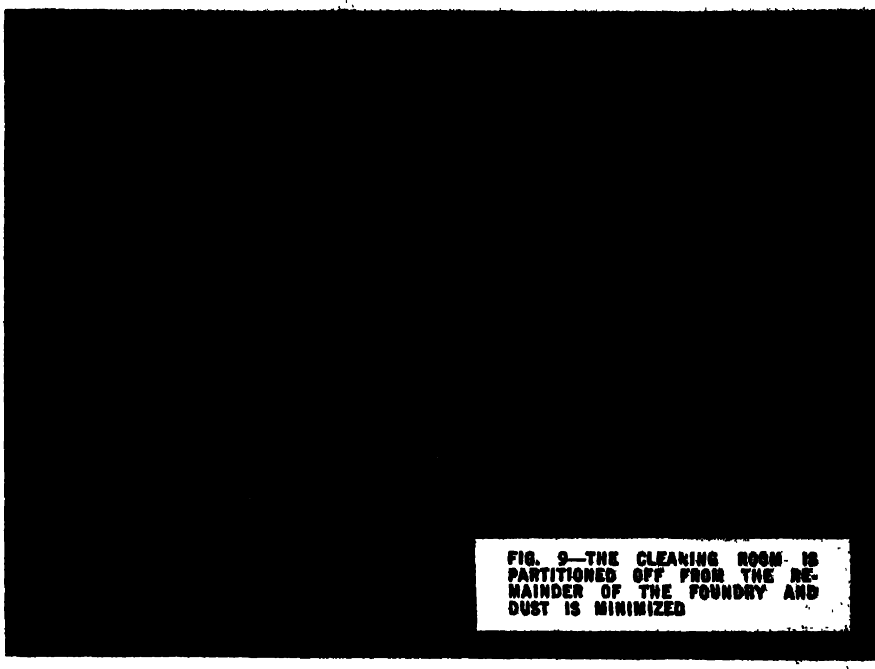


FIG. 9—THE CLEANING ROOM IS PARTITIONED OFF FROM THE REMAINDER OF THE FOUNDRY AND DUST IS MINIMIZED

supplied by the Arcade Mfg. Co., Freeport, Ill. A similar machine is used for riddling the facing sand used by the molders. These machines are mounted on wheels and may be moved to any convenient location. A number of hand-propelled trucks like these illustrated in Fig. 6 are used for transporting the large cores from the core room to the molding floor.

The two core ovens are situated side by side with a dividing wall between. The fire places are located underneath at one end of a chamber which conducts the heat into the oven through a series of rectangular openings in the floor. Access is had to the firing chamber by a flight of steps leading down from an opening in the passage separating the end of the foundry building from the storage bins

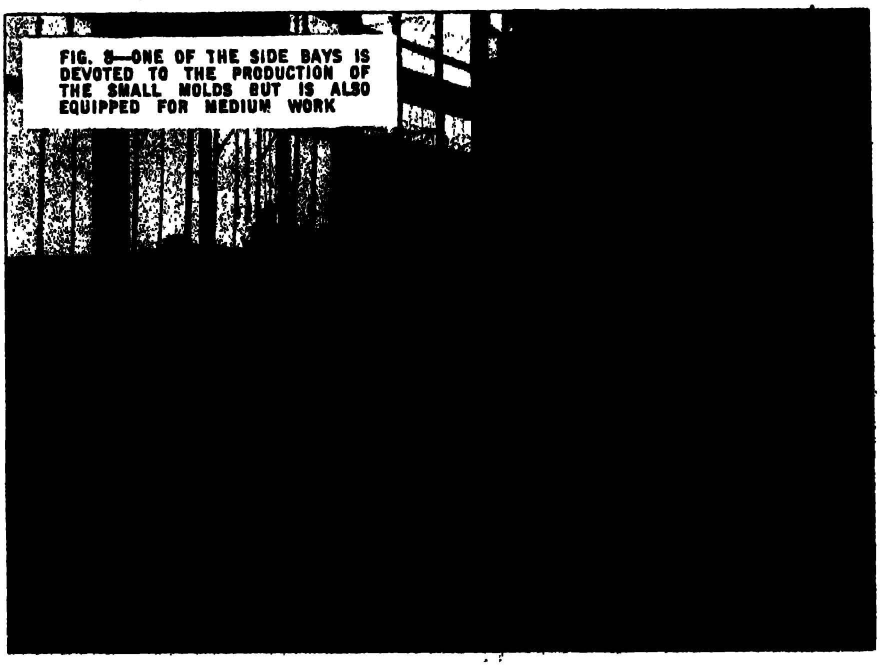


FIG. 8—ONE OF THE SIDE BAYS IS DEVOTED TO THE PRODUCTION OF THE SMALL MOLDS BUT IS ALSO EQUIPPED FOR MEDIUM WORK

and the stockpile. A round opening a short distance from the stairway and provided with a cover when not in use is the medium through which coke is dumped down into the chamber in front of the firing doors. Each oven is 6 x 8 x 10 feet and capable of accommodating two of the 5-deck cars. These cars may be either used singly or coupled together for supporting long cores.

Two similar ovens are provided for drying molds in case such a contingency should arise. The fireplace for these ovens is inside the foundry building. A wash, locker and toilet room is situated over these two ovens and is separated from the charging floor of the cupola by a brick wall. Access is had to the room by a stairway situated between one of the ovens and the wall of the cupola room. A space between the ovens and the end of the building is utilized as a molding floor for making small pulleys and shaft hangers. This class of castings is a fairly standard product and is made in considerable quantities on a pneumatic, jolt, pattern draw roll-over machine made by the Tabor Mfg. Co., Philadelphia.

Melting Facilities Modern

The floor back of the ovens, with the exception of the space taken up by the firing pit, is devoted to the manufacture of brass castings. Two pit furnaces of the ordinary coke fire, natural draft type are used for melting the brass.

As may be seen from the illustration, Fig. 1, the cupola room is entirely enclosed by a brick wall the only openings in which are a door in front together with two openings for the

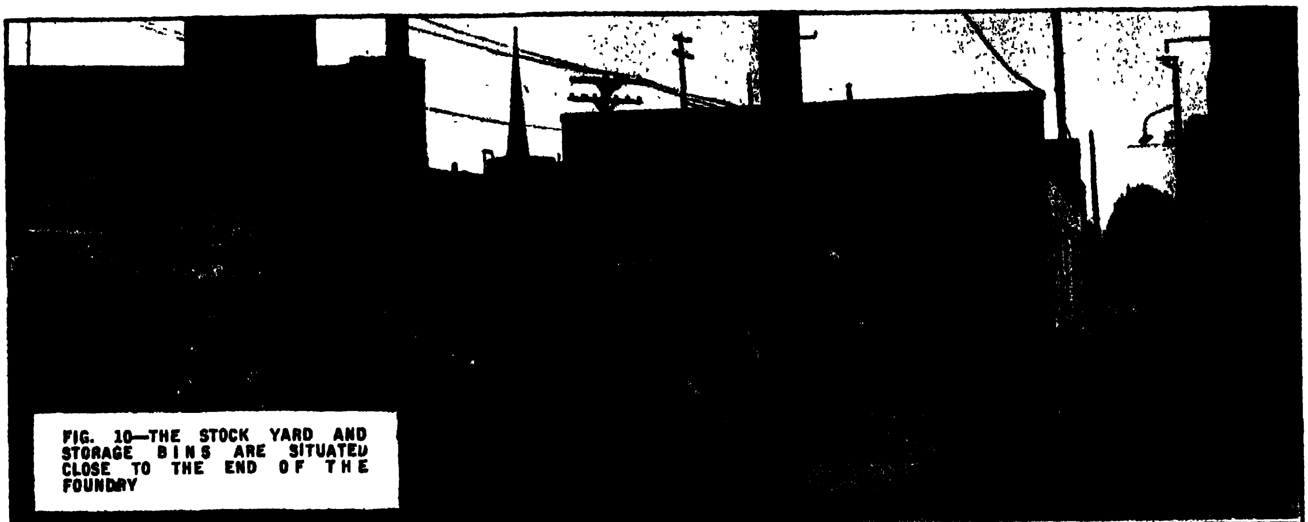


FIG. 10—THE STOCK YARD AND STORAGE BINS ARE SITUATED CLOSE TO THE END OF THE FOUNDRY

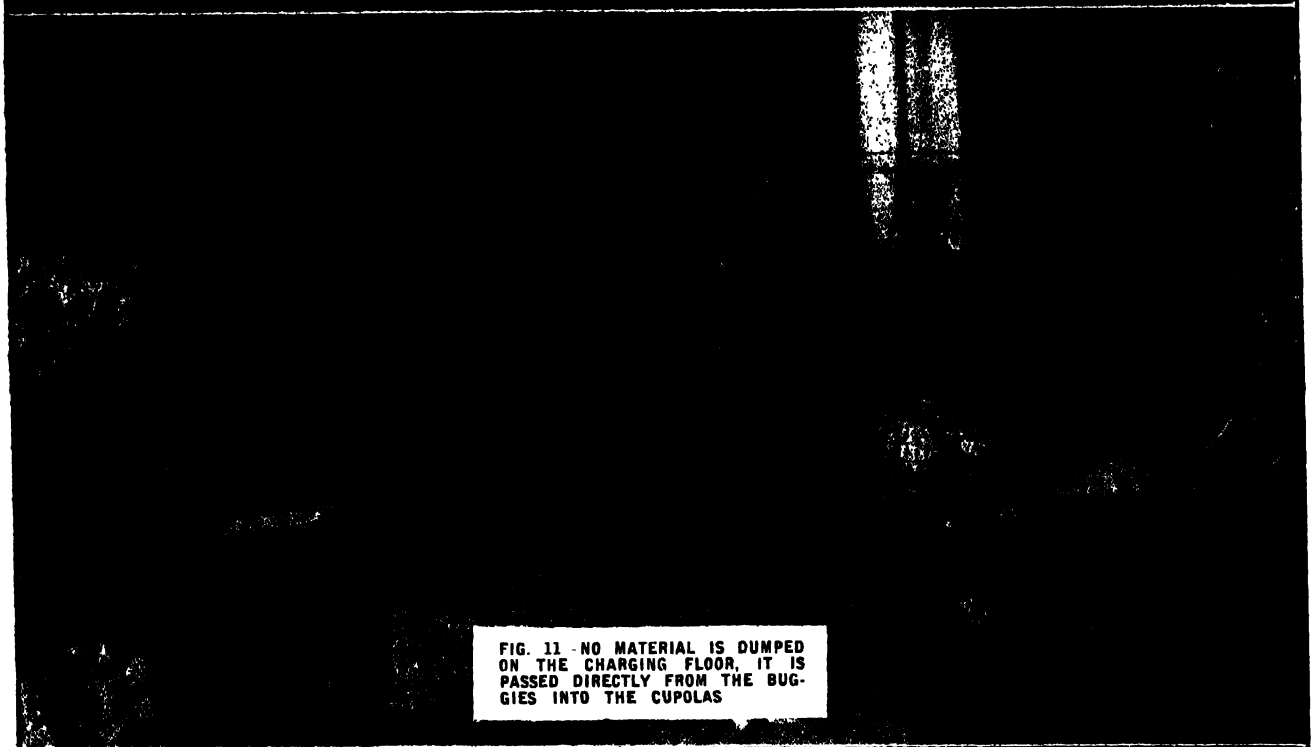


FIG. 11—NO MATERIAL IS DUMPED ON THE CHARGING FLOOR, IT IS PASSED DIRECTLY FROM THE BUGGIES INTO THE CUPOLAS

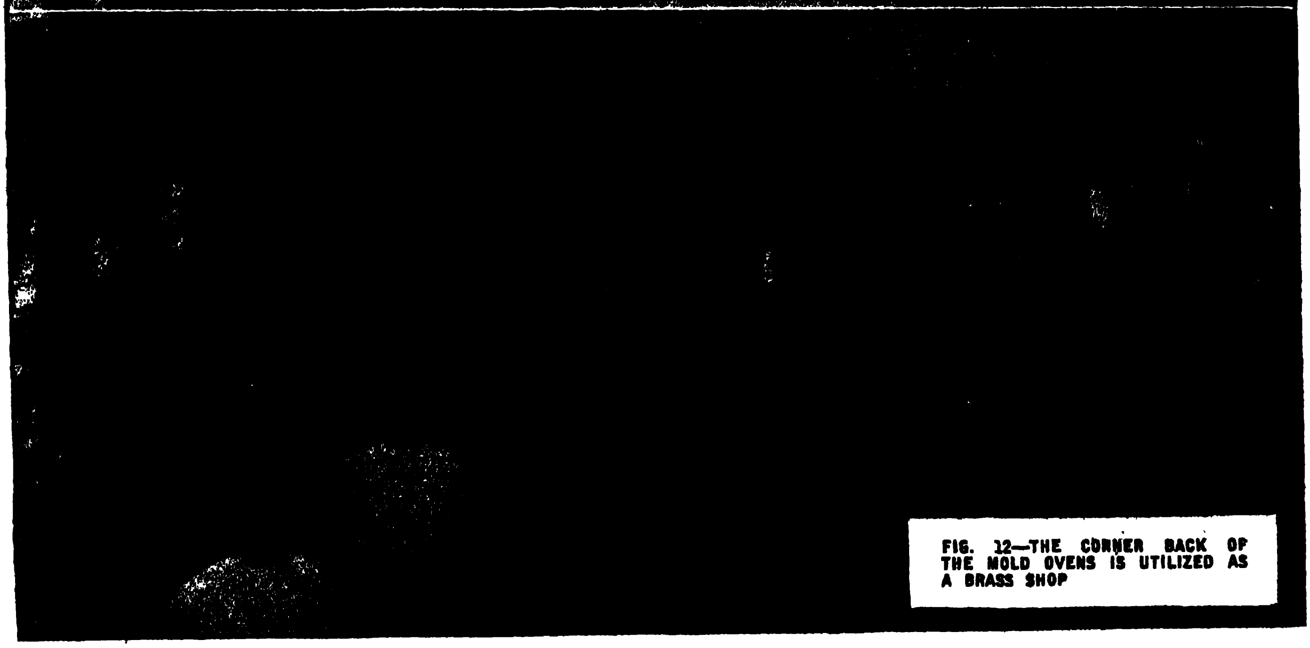


FIG. 12—THE CORNER BACK OF THE MOLD OVENS IS UTILIZED AS A BRASS SHOP

cupola spouts; and another door at the back communicating with the elevator. Two cupolas supplied by the Whiting Foundry Equipment Co., Harvey, Ill., are used for melting the iron. The volume of work varies considerably so there is no regular sequence in using the cupolas. When the heat is heavy the large one is used and when the heat is light the iron is melted in the small cupola. The large cupola has a shell 72 inches in diameter and the small one 52 inches. Each cupola is double lined up to the charging door. Therefore the large cupola has an inside diameter of 54 inches and the small one 34 inches. The charge for the small cupola consists of 1000 pounds of coke on the bed followed by alternate layers of iron and coke in the ratio of 1 to 8. The composition of the charge varies occasionally on account of the work in hand but a typical charge is made up of pig iron and scrap in the proportion of 1000 pounds of pig iron to 600 pounds of scrap. From one to three brands of pig iron are constantly used in varying proportions depending on the kind of work which has to be poured on any particular day.

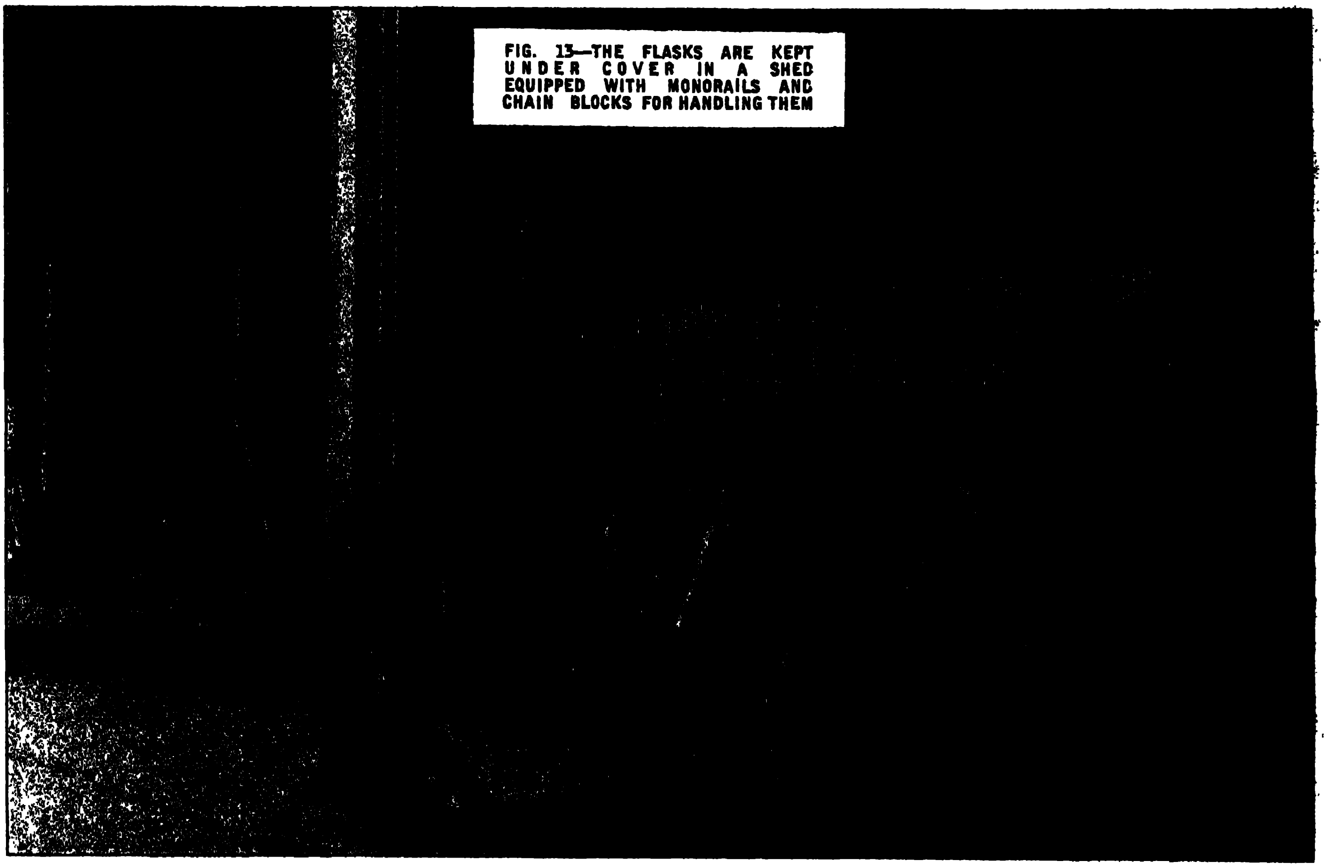


FIG. 13—THE FLASKS ARE KEPT UNDER COVER IN A SHED EQUIPPED WITH MONORAILS AND CHAIN BLOCKS FOR HANDLING THEM

A spur from the Wabash railroad runs through the yard and the material is unloaded directly from the cars. The pig iron is piled in neat and orderly rows. The coke is unloaded into a large bin and the sand, facing, lime stone, etc. are unloaded into a row of covered concrete bins separated from the end of the foundry building by the width of a plank walk.

The charge for the cupola is made up on a number of trucks and weighed on a Fairbanks platform scale situated in the plank walk in front of the elevator door. No material is dumped on the charging floor. The iron and coke is transferred direct from the cars to the cupola.

Several buildings are devoted to the storage of the immense stock of patterns which the company has accumulated in the years it has been doing business. As has been stated, the Defiance company does a great deal of special work but it also issues a catalog of over 700 different standard machines. These machines go to all parts of the world and it is nothing uncommon for the company when engaged in preparing a new issue of the catlog and preparing to eliminate some of the machines which have not figured on the order books for years to receive orders for some of the parts. The patterns are so arranged in the pattern storage and card indexed in the office that it is no trouble to find any given pattern at any time. A small building immediately in front of the main foundry door is utilized for storing the *live* patterns, that is the patterns that are actually in use in the foundry. They are placed there a day or two before they are needed in the foundry and are returned after the molders are through with them, pending their removal to the permanent pattern storage.

The molding flasks, both wood and iron, are stored in a building, 60 x 132 feet, separated from one side of the foundry building by a wide concrete gangway. This building is of steel frame construction and is made with one side, two ends and a roof. The side nearest the foundry is open the full length which permits flasks to be placed in the building or removed from any point with a minimum of trouble. A number of monorails supporting Yale & Towne chain blocks span the building from side to side and serve to handle the heavy flasks. The lift trucks are employed for conveying the flasks to and from the foundry.

The American Foundry Equipment Co. having outgrown its sales and executive offices at 52 Vanderbilt avenue, New York, has removed to a large suite in the Marlin-Rockwell building, 366 Madison avenue.

The Henry-Miller Foundry Co. recently changed its name to the Henry Furnace & Foundry Co. This company operates plants at Cleveland, Medina, Chagrin Falls and Canton, O.

How and Why in Brass Founding

By Charles Vickers

Heat Resisting Alloys to Meet Pressure Tests

We are having difficulty in making castings for gasoline burners owing to the fact that they will not withstand the pressure of 50 pounds of compressed gasoline with which they are tested. The burner works at a white heat, and we lose from 25 to 33 per cent of the castings we make. We have many different methods of molding but have the best results with upright pouring, and heavy shrink balls as feeders. We have used both oil-fired and coke-fired furnaces in melting. The coke-fired gave the best results. We pour the metal hot and an alloy of copper 90 per cent, tin 10 per cent, gives the best results. We have tried the following alloys: (1) Copper, 70 per cent; tin, 5 per cent; lead, 2.50 per cent, and zinc, 1.50 per cent. (2) Copper, 84 per cent; tin, 14 per cent; zinc, 2 per cent.

The cores are made with rosin binder; we have tried other mixtures, but rosin appears to be the best. We would be grateful for any suggestions you may be able to offer.

The following alloy is frequently used for gasoline burners: Copper, 78.75 per cent; zinc, 15 per cent; lead, 3 per cent; tin, 3 per cent, and phosphor copper, 0.25 per cent. A stronger alloy having a good reputation for withstanding pressures follows: Copper, 82 per cent; tin, 7.50 per cent; lead, 5.50 per cent, and zinc, 5 per cent. None of the above alloys will work at a red heat, however, as the metal will soften and crumble. For a red heat it will be necessary to use an aluminum bronze containing iron, but this alloy is difficult to cast so that it will withstand pressures. Nickel alloys work well at high temperatures, but also are difficult to cast. The following alloy is worth trying: Copper, 88 per cent; tin, 9 per cent; nickel, 1 per cent, and zinc, 2 per cent. Alloys of copper with less than 8 per cent tin are not good for high temperatures. A low brass, such as copper, 90, and zinc, 10 per cent, withstands heat better than the bronzes, while an alloy of copper with 5 per cent nickel is better than the zinc alloys. It may be possible that the design of the casting is faulty. If leaking persists at certain places, it would be advisable to smooth wax onto the pattern at the leaky points, thus thickening the walls, or rounding out the corners, then test a few heats of the improved patterns. As the molding, melting and coremaking part of the process of making these castings appears good, we are inclined to think the fault lies in the design of the castings and would suggest that all corners be well filleted and the parts most susceptible to leakage be increased in thickness.

Mention is made of the castings being worked at a white heat; at such a temperature the metal would melt and run like water, consequently we will assume that it is meant the flame appears at a white heat; the metal itself cannot be red hot, otherwise no copper alloy is suitable for the service. It will do no harm to add 2 per cent nickel to the copper, 90 per cent, tin, 10 per cent alloy, as it will have the effect of closing the grain of the metal.

Molding Sand Mixtures for Aluminum

We are contemplating engaging in the manufacture of aluminum castings for vacuum sweepers, making around 200 per day, and would like to learn all it is possible to know about this subject, with especial reference to molding and core sands, binders and mixtures of metals.

Molding sand of suitable quality can be supplied by any of the regular supply houses. It must be open in texture and not too coarse in grain. Cores for vacuum cleaner castings must be soft and friable, otherwise the castings will crack in cooling. What is known as the mixture for shell cores will be satisfactory. This is made as follows: Old molding sand from the floor, 8 shovelsfull; silica sand, 3½ shovels; new molding sand, 4 shovels; fine sawdust, 1 shovel. Riddle this mixture through a ¼-inch riddle after mixing the same thoroughly. The binder consists of 1 quart molasses previously mixed with the sawdust. The mixture must be thoroughly mixed, by milling and sieving.

The most suitable alloy to use consists of copper 8 per cent, aluminum 92 per cent. An oil or gas-fired furnace fitted with an iron melting pot is satisfactory for melting aluminum for the class of castings it is desired to make.

Alloys Recommended for Bearing Metal

We are experiencing difficulty with a highly leaded alloy. The lead appears to separate leaving spots on the finished surfaces of the casting. The metal is bought ready mixed in ingot form, and has the following composition: Copper, 72 per cent; zinc, 9 per cent, and lead, 19 per cent.

The difficulty is due to the alloy which is not a practical mixture. The remedy is to change the formula and obtain a mixture that can be cast in sand and produce castings free from the difficulty outlined. It is presumed that the mixture is used for bearing purposes, otherwise, it would not contain such a large amount of lead as you have mentioned.

The following mixture is better and will quickly save its increased cost because the castings will be good, instead of scrap. To make the mixture take 55½ pounds of alloy containing copper, 72 per cent; zinc, 9 per cent, and lead, 19 per cent, and weigh 30 pounds of copper, either scrap or ingot, place the copper in the bottom of the crucible, if the latter is used, or in the bottom of the furnace, if of the non-crucible kind, then place the 55½ pounds of alloy on top of the copper and melt, using a cover of charcoal. When the mixture is molten, add 9½ pounds lead and 5 pounds tin. This will produce an alloy of the following composition: Copper, 70 per cent; tin, 5 per cent; lead, 20 per cent, and zinc, 5 per cent. This is a very satisfactory bearing mixture. It can be used for any purpose the ingot metal was intended for and will give much better results.

Brass for Name Plates

We have a number of name plates to make and would feel favored to receive suitable mixtures, for both red metal and yellow brass castings which may answer for this purpose.

A good red metal for name plates is the following: Copper, 90 per cent; tin, 6 per cent; zinc, 2.50 per cent, and lead, 1.50 per cent. For a yellow mixture use, copper, 70 per cent; zinc, 25 per cent; lead, 3 per cent, and tin, 2 per cent.

Electrical Melting of Alloys---IX

Rapid Strides Made in the Development of Electric Brass Furnaces Have Introduced Changes in the Past Few Months—Statistical Study Presented

H. W. GILLETT

FORMER articles of this series have described the more prominent types of electric furnaces for melting brass. It remains, before discussing questions of choosing a particular furnace for a particular job, of installation and of operation, to deal briefly with a few other furnaces and with some of the newer developments on those already described. The moves in developing electric brass melting are made so rapidly now-a-days that it is difficult to keep up with them all. An example of the trend in industry is furnished by two firms which formerly specialized in buying borings and similar scrap, briquetting them and selling the briquets. These companies have had their business diminished in consequence of their former customers having found it cheaper to handle their own scrap by electric melting, and both are planning to install electric furnaces and sell ingot metals.

FIG. 1 — INSTALLATION OF DETROIT ROCKING FURNACE IN POURING POSITION

FIG. 2—DETROIT ROCKING FURNACES EQUIPPED FOR DIRECT POURING—FURNACE AT THE LEFT IN ROCKING POSITION, AT THE RIGHT, IN POURING POSITION

As to individual advances, taking these up in the order in which the furnaces have been dealt with in this series of articles, it may be noted that the Ajax-Northrup furnace, which has been taken over by the Ajax Electrothermic Corp., Trenton, N. J., has been developed so that high-frequency furnaces of 100 kilowatts now are considered commercially feasible. A new high-frequency generator of simple design has been tried with gratifying results. Even with the condensers and oscillatory current that must be relied upon until the high frequency alternator is ready for use, rapid progress has been made, a 3-phase system having been developed by which the capacity of each condenser has been largely increased and hence the cost of the outfit per kilowatt decreased. A 60-kilowatt nose-tilting furnace of 500 pounds capacity just built for melting silver, shows a power factor of about 70 and is expected to melt sterling silver at 250 kilowatt hours per ton, since much smaller furnaces at the Philadelphia mint have been handling coinage silver at the rate of 270 kilowatt hours per ton. The previously feared danger to life from the high voltage, high frequency current seems to be groundless, as recent tests indicate that the current used is not dangerous. Prospects look bright for the production of high-frequency current melting outfits at a cost no greater than that of other types of similar sizes, and, in the smaller sizes, say 20 to 30 kilowatts, probably at a lower cost. That is, there is hope of ultimately extending electric furnace operation to the small shop with low production, since the Ajax-Northrup type is more suited to intermittent operation than other types. The General Electric Co., Schenectady, N. Y., also is paying attention to the small shop, and is developing a 30 kilowatt crucible lift-out, single phase furnace. This is planned for such work as that of metallurgical laboratories of manufacturing jewelers, and of such shops as have to melt small quantities of nonferrous metals in rooms where the use of a fuel-fired furnace is inadmissable. The crucible takes 25 pounds and the furnace is planned to make two heats an hour after it is hot. The heat is generated in a similar manner to that in the General Electric hearth furnace, being radiated and reflected to the crucible instead of to

a hearth. The power consumption is high, being calculated at the rate of 1200 kilowatt hours per ton with the furnace hot. The furnace naturally is not one of much interest to a plant with any appreciable output of nonferrous metals, but may be of interest where cleanliness and convenience are paramount in the melting of small quantities of metal.

A recent development in the rocking arc type furnace, that of a form adapted to direct pouring, was mentioned in a previous article, but details were not then available. Figs. 1 and 2 show direct pouring Detroit Rocking furnaces in process of erection. In this form the furnace while melting rests on an improved base, which now is also used in the ladle-poured forms, having superseded the form shown in the photographs on page 403 of the May 15 issue. When pouring, the furnace is rocked forward till the bar in front engages the sockets in the front of the base and a lifting screw at the rear is swung into position so that it engages the rear hinge. The motor-actuated screw then rises, lifting the furnace bodily off the gears and rollers, so that the furnace is supported and tilted like all nose-tilting or direct-pouring furnaces. The bar is located below the lowest position of the spout during rocking and hence does not interfere with the motion. Figs. 1 and 2 also show an overhead charging platform.

Some recent data on rocking furnace performance in the 1-ton size, showed less than 210 kilowatt hours per ton on 24-hour operation with clean charges of 60-40 brass in rolling mill work, on a 50-ton run, made at a rate to give an average output for the furnace of 18½ tons per day.

Another 1-ton furnace is claimed by the users to give 6 tons per day at about 280 kilowatt hours per ton in 10-hour operation on melting cabbaged wire and scrap copper into wire bar, and to produce metal of 100 per cent conductivity, Mattheisen scale, without the use of fluxes or deoxiders These results, both as to power consumption and quality of product require expert operation.

Of the furnaces not yet described, one is an indirect arc furnace in which the furnace is kept in motion while operating thus falling into the same general class as the Detroit, the American, and the Booth furnaces. This the Moore Rapid 'Lectromelt furnace, sold by the Pittsburgh Furnace Electric Corp., Pittsburgh. Although the furnace has been advertised for some months, no detailed description has been given out, even to prospective users, and no commercial installations have been made, though one experimental furnace is said to have been constructed. The only approach to a description is the following, taken from advertisements of the furnace.*

"Heat is transmitted to the charge by distributed radiation and reflection only. Arcs are struck between the electrodes rather than against the charge. Segregation and volatilization are minimized. They use polyphase or single-phase power."

Another rocking indirect arc furnace recently has been described by Reardon,** which is said to have been thought of in December, 1913, but on which it is stated that no figures were available in May, 1920. The idea is to insert electrodes in place of the oil burners in a Schwartz furnace. The bureau of mines converted a 100-pound Schwartz furnace into an electric unit in this way in March, 1913, and did not rock it while running.

Reardon's present idea is to rock the furnace, but on account of the location of the charging door and pouring spout, only about half the lining can be washed by the metal, which will tend to give a short lining life in the unwashed portion. Reardon specifies 300 kilowatts, for a 1-ton furnace, the normal power input for electric brass furnaces of that capacity, but plans to use 220 volts, which the writer believes would give too long an arc for good results. This makes the fifth modification of the moving indirect arc furnace to be designed for brass melting.

While the possibility of utilizing old Schwartz furnace shells is interesting, the writer believes it to be cheaper in the end to use an electric furnace designed as an electric furnace rather than a made-over oil furnace

TABLE I
Electric Furnaces for Nonferrous Melting
Direct Arc Furnaces

Make	No	User	Alloy	Capacity tons per heat per furnace	K W rating per furnace	Total K.W.	Remarks
Heroult	2	Driver Harris Co , Harrison, N. J.	nickel alloys	2	800	1600	Automatic electrode control
Greaves-Etchell	1	Hoskins Mfg Co , Detroit	nickel alloys	½	300±	300	Automatic electrode control
Snyder	1	Monel Metal Products Co , Harrison, N J.	Monel	¼	100	100	
Snyder	1	Monel Metal Products Co , Harrison, N. J	Monel	2	400±	400	
Snyder	1	Chrobaltic Tool Company, Chicago, Ill.	cobalt chromium	1/8	60	60	
Snyder	3	Haynes Stellite Co , Kokomo, Ind	cobalt chromium	1/8	60	240	
Snyder	2	Chicago Bearing Metal Co , Chicago, Ill	bearing bronze	1	400	800	Automatic electrode control
Total	11					3500	

Harvey Modified Indirect Arc

A sixth modification has recently been patented by an English designer,* in which a furnace proportioned something like a pint milk bottle with a rounded bottom, has its neck closed by a door carrying either a solid resistor, or electrodes between which an indirect arc is struck. The furnace chamber is tilted off the vertical, and then rotated or rocked, the idea being to wash as much of the walls with the metal as possible.

The use of a solid resistor so supported seems impractical to the writer, and arc electrodes so inserted would be in a cramped position, both as regards adjustment from the outside and the location of the arc inside.

Another furnace which has not been described in detail is not yet on the market. This unit, which is in full commercial operation on alloys ranging from yellow brass to pure copper, is the Bennett, which was developed at and for the Scovill Mfg. Co., Waterbury, Conn., after long and thorough experimental work on many other types of furnaces. Instead of being heralded with a flourish of trumpets before any furnaces were in commercial operation, this has been a *mystery* furnace. The men who designed and developed the furnace have been unable to discuss it freely or to give out any data whatever on its performance, on account of the

*Metal Ind , Vol. 18, Feb., 1920, Advt. p. 10. Elec. World, Vol. 75, April 24, 1920, Advt. p. 98.

**Reardon, W. J., Electric Melting in an Oil Furnace, Metal Industry, Vol. 18, 1920, p. 207.

*Harvey, L. C., U. S. Pat. 1337839, April 20, 1920.

company's very strict policy of secrecy.

It has not yet been decided whether the furnace will be made available to other users, or kept solely for the Scovill Mfg. Co. In the former case, prospective users naturally will demand data by which it may be compared with the furnaces on the market, but unless and until that situation arises, the furnace probably will remain behind a dark veil of secrecy, instead of in the spotlight.

The only published information is that found in a recent patent,* and this, according to its inventor "does not cover all the points, as many important features are still in the patent office, and patent applications on more features are still to be made." The patent is for a process, rather than a furnace, and obviously is not worded to impart any more information than can be helped.

However, the installation demands consideration, because it is in commercial operation in a rolling mill of high standing. There are six 1-ton and one 5-ton Bennett furnaces in operation at the Scovill plant, the latter being the largest electric brass furnace yet built. Moreover, the principle used is a vastly interesting one from the point of view of theory.

Briefly, the furnace closely resembles an ordinary 3-phase Heroult, direct-arc, steel furnace, which uses 50 to 75 volts between each electrode and the charge, which, as has been shown before, will not operate on alloys high in zinc without excessive metal loss. The main point of difference is that the Bennett furnace is not run as an arc furnace but as a *contact resistance* furnace. There usually is supposed to be a minimum voltage below which a true arc cannot be struck, or held. Nevertheless, if a voltage below this minimum be impressed on a circuit in which there is a poor contact, current will flow and resistance heating will be set up at the poor contact. It is possible in melting yellow brass, that a little zinc vapor might be evolved at the poor contact and that current would then flow along the vapor. This, however, would hardly explain the action of the furnace when melting copper. According to the patent, the voltage between any one electrode and the charge should be from 18 to 20 on the 1-ton size, while on the 5-ton size, 32 to 40 volts may be used.

This is quite analogous to electric furnace practice used abroad for melting ferromanganese for making additions to steel. Manganese is fairly volatile, and somewhat the same problem arises as on alloys containing zinc.

*Bennett, M. H., U. S. Patent, 1337305, April 20, 1920.

Rodenhauser* discusses the question in considerable detail. He shows that the various ferromanganese melting furnaces used are run at far lower voltages than in melting steel. On ferromanganese the Heroult and Girod furnaces are run at around 45 volts and require a thick slag to prevent volatilization, the Keller, at around 30 volts, requiring a thinner slag, and the Schemmann and Bronn, at around 20 volts with only a trace of slag.

Bennett emphasizes the necessity for keeping the voltage low, and for keeping the rate of power input down, so that the heat may be distributed through

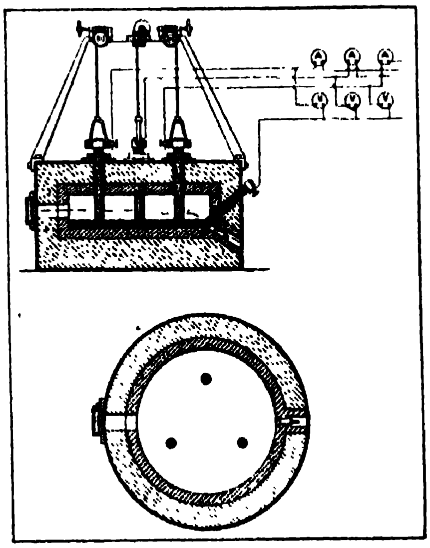


FIG. 3—PATENT OFFICE DRAWINGS ILLUSTRATING ANNOUNCED FEATURES OF THE BENNETT FURNACE

the charge and not pile up near the electrode, both in order to avoid too great local overheating.**

He also stipulates that the arrangement of the electrodes should be such as to set up an electromagnetic field in the metal and produce slight circulation of the metal in order to get what stirring is possible, to avoid local overheating. This is similar to the Heroult furnace.

Circulation Not Sufficient

As Hess*** points out, however, the circulation in the Heroult furnace is not sufficient to give proper mixing of steel without further stirring.

According to the patent, the Bennett furnace takes 2500 amperes per electrode in the 1-ton size and 4200 in the 5-ton. With the voltages given between electrode and charge and with

*Rodenhauser, W., Ferromangan als Desoxydation Mittel—1915, p. 26. See also Schemmann, W., and Bronn, J. U. S. Pat. 1056456.

**Compare the author's comments, The Foundry, Vol. 48, 1920, April 15, pp. 319, 320, and the use of the DeNolly Grammont ferro-manganese melting furnace on brass, p. 320.

***Hess, H. L., Electric furnaces as applied to steel-making, Mech. Eng., Vol. 41, 1919, p. 245; Chem. Abstr., Vol. 14, 1920, p. 16.

the probable power factor, these figures, in a 3-phase furnace, calculate to a power input of around 150 kilowatts in the 1-ton and 500 kilowatts in the 5-ton size. This is a lower rate of power input than is used in such furnaces as the rocking type or the General Electric and is almost as low as in the Baily. The ratio of heat usefully applied to that lost by radiation will therefore be low and the efficiency therefore not high. This condition is helped considerably by the fact that the heat is generated close to the charge. The furnace should have an efficiency above the Baily, and General Electric furnaces; of the same order as the Rennerfelt reverberatory, and direct arc and stationary indirect arc furnaces, and below that of the rocking arc or the induction types. The metal losses are said to be low. The refractory life cannot be estimated.

The furnace must be successful, or the Scovill Mfg. Co. would not use it, and if it is ever put on the market, there will be still another electric brass furnace added to the different types the brass melter has to choose from.

The furnace, as shown in the patent drawings, is illustrated in Fig. 4. The figure is highly diagrammatic. The writer doubts if the furnace has a flat roof, if the charging door is as small as is shown, or if the electrodes are hand-regulated from up in the air as shown. The object that looks like an electrode at the right does not carry power, but merely serves to show the voltage between the three electrodes and the bath, so that the proper voltage may be maintained, which is undoubtedly done automatically in the actual furnace.

So much for the electric brass furnaces in commercial use and being developed for that end. It has been shown that electric melting is commercial for nickel alloys, silver, copper, brass and bronze. Only one important class of nonferrous alloys remains for which electric melting need be considered—the light aluminum alloys.

Data on electric melting of aluminum is about as scarce as that on electric brass melting was three or four years ago, and it is necessary to consider it more from the point of view of theory than from present practice. According to data recently gathered by the bureau of mines* about 45,000 tons of light aluminum alloys are produced in the United States every year, around 98 per cent of this being aluminum-copper alloys and only 1 2-3 per cent or 750 tons being aluminum-zinc, or aluminum-copper-zinc alloys. A single electric furnace, of around 1-ton capac-

*Anderson, R. J., Casting Losses in Aluminum Foundry Practice, bulletin U. S. bureau of mines (soon to be published).

TABLE II

Furnaces for Nonferrous Melting

Moving Indirect Arc Furnaces

Make	No	User	Alloy	Capacity tons per heat per furnace	K.W. rating per furnace	Total K.W.	Remarks
Detroit rocking	2	Aluminum Mfgs Inc., Detroit	brass and bronze	1	300	600	
Detroit rocking	2	American Bushing Corp., Marysville, Mich.	brass and bronze	1	300	600	
Detroit rocking	2	American Manganese Bronze Co., Holmesburg, Pa.	brass and bronze	1	300	600	
Detroit rocking	5	C. B. Bohn Foundry Co., Detroit	4 on brass and bronze 1 on Al	1	300	1500	
Detroit rocking	2	Bound Brook Oilless Bearing Co., Bound Brook, N. J.	bronze	½	150	300	
Detroit rocking	1	Bridgeport Brass Co., Bridgeport, Conn.	bronze and copper	1	300	300	
Detroit rocking	4	Chase Metal Works Co., Waterbury, Ct.	brass	1	300	1200	
Detroit rocking	1	Cleveland Brass and Copper Rolling Mills, Cleveland, O	brass	1	300	300	
Detroit rocking	4	Detroit Copper and Brass Rolling Mills, Detroit	brass	1	300	1200	3 nose-tilting furnaces
Detroit rocking	1	Ford Motor Co., Detroit	brass and bronze	1	300	300	
Detroit rocking	1	Ford and Son, Dearborn, Mich	brass and bronze	1	300	300	
Detroit rocking	2	General Aluminum and Brass Mfg Co., Detroit	brass and bronze	1	300	600	
Detroit rocking	1	General American Tank Car Corp., E. Chicago, Ill	brass and bronze	½	150	150	
Detroit rocking	1	Hills, McCanna Co., Chicago, Ill	brass and bronze	¼	75	75	
Detroit rocking	1	Lumen Bearing Co., Buffalo, N. Y.	brass and bronze	½	150	150	
Detroit rocking	2	Michigan Lubricator Co., Detroit	brass and bronze	1	300	600	
Detroit rocking	4	Michigan Smelting and Refining Co., Detroit, Mich	brass and bronze	1	300	1200	
Detroit rocking	2	Mueller Metals Co., Port Huron, Mich.	brass	1	300	600	
Detroit rocking	1	Oregon Brass Works, Portland, Oregon	brass and bronze	1	300	300	
Detroit rocking	1	Oregon Brass Works, Portland, Oregon	brass and bronze	½	150	150	
Detroit rocking	3*	Parish Pool Co., Cleveland, O.	brass and bronze	1	300	900	2 nose-tilting furnaces
Detroit rocking	1	Rome Wire Co., Rome, N. Y.	copper	1	300	300	
Detroit rocking	3	Sherwood Brass Works, Detroit	brass and bronze	1	300	900	
	50**					13,800	

* One of these was formerly used at the Denny-Rine Co., which went out of business.
** 43-300 K.W.; 5-150 K.W., 2-75 K.W.

Among the users of Booth* furnaces are the following

Leitelt Bros., Chicago	⅛ ton
Dearborn Brass Co., Cedar Rapids, Iowa	⅛ ton
Muskegon Aluminum Foundry Co., Muskegon, Mich.	⅛ ton
National Bronze and Aluminum Foundry, Cleveland	¼ ton
Cleveland Brass Mfg. Co., Cleveland	¼ ton
Fulton-Haywood Brass Works, South Bend, Ind.	¼ ton
Dallas City Foundry Co., Dallas City, Ill.	¼ ton

* The 7 furnaces above have been in operation for some time, a total of 20 furnaces had been shipped June 1, and some of the others have been put in operation. The names of the other purchasers have not yet been given out.

This makes the Booth entry in the summary of totals read

Make	No	Capacity tons per heat per furnace	K.W. rating per furnace	Total K.W.
Booth	8	⅛	75	600
	20	¼	125	2500
	4	½	180	720
	3	1	300	900
Totals	35			4720

Make	No.	User	Capacity	Total K.W.
American	1	York Hardware & Brass Co., York, Pa.	½ ton	300

ity, could melt all the zinc-containing aluminum alloys produced in the country and not have to work much over 10 hours a day to do it.

Since it is only the zinc-containing aluminum alloys in which there is any noteworthy volatilization loss, it is plain that the situation in aluminum is diametrically opposed to that in brass. Oxidation losses do occur, and considerable good metal is entangled in, and skimmed off with the dross, but the net loss of metal in melting the standard No. 12 alloy is probably only somewhere between 1 and 2 per cent. Moreover, those who have had the most experience in electric melting of aluminum doubt that, with the same charge to start, an electric furnace will save enough metal over a well-operated fuel-fired furnace to make much difference on the cost sheets.

The bulk of the aluminum is melted either in iron pots or some type of reverberatory furnace. Where it is still melted in graphite crucibles the pots have a relatively long life.

Hence two of the outstanding advantages of electric brass melting, reduction of metal losses and avoidance of high crucible costs, do not obtain in any marked degree in electric aluminum melting. Therefore, on aluminum, electric melting must justify itself on the score of quality, ease of control, decreased labor cost, or lower cost of electric power than of fuel required.

Quality Is Good

As to quality, every one who has tried electric melting seems to agree that electrically melted aluminum is of good quality, and some seem to feel that it is, or may be, superior. Perhaps because of the good general reputation of the electric furnace on the score of quality in handling of other alloys, some aluminum founders are hoping that the electric furnace may do away with cracks, draws, and porous castings, or may at least eliminate the possibility of these troubles originating in the melting of the metal, thus leaving only the thousand and one molding and core causes that may produce these evils.

Some work has been done on testing the product for porosity in a scientific manner which indicates that the electric furnace offers possibilities, but even these tests often were discordant and contradictory. It can be said with considerable confidence that a reducing atmosphere is better for finishing steel and melting brass than an oxidizing atmosphere. However, in view of the oxidizing atmosphere over an iron pot furnace for aluminum, and the fact that such furnaces can produce good

TABLE II—(continued)

Electric Furnaces for Nonferrous Melting

Stationary Indirect Arc Furnaces

Make	No.	User	Alloy	Capacity tons per heat per furnace	K.W. rating per furnace	Total K.W.	Remarks
Rennerfelt	1	Gerline Brass Foundry Company, Kalamazoo, Mich.	brass, bronze and monel	⅛	100	100	
Rennerfelt	2	Chicago Bearing Metal Co., Chicago, Ill.	bearing bronze	1	300	600	
Rennerfelt	1	U. S. Mint, Philadelphia, Pa.	bronze and silver	½	150	150	Automatic control, nose-tilting
Rennerfelt	1	U S Mint, Philadelphia, Pa	bronze and silver	1	300	300	Automatic control, nose-tilting
Rennerfelt	1	U. S. Mint, San Francisco, Cal	bronze and silver	½	125	125	Automatic control, nose-tilting
Rennerfelt	1	Bausch Machine Tool Co., Springfield, Mass	hardeners for aluminum	⅛	100	100	
Total	7					1375	

metal, and that in a reverberatory type aluminum furnace the atmosphere may be made reducing, and that this type can also produce good metal, as well as bad, one is not justified, on present data, in jumping to a conclusion that an electric furnace need be good for aluminum because it may have a reducing atmosphere.

Neither on the score of theory nor of recorded foundry tests of electric aluminum furnaces can assumption be made that any definite direct advantage arises from the electric furnace, save perhaps in the elimination of hard spots in the castings, due to iron scale from the iron pot, an advantage shared by fuel-fired hearth type furnaces as well.

In case of control, there is a real advantage, because of the great effect that the rate of solidification, i.e., the pouring temperature, has on aluminum. Though it has never been satisfactorily explained, and hardly fully proved, there is a general idea that aluminum, once overheated, in either a reducing or oxidizing atmosphere, is thereby irreparably injured, even though it be poured at the proper temperature. If this be so, then an electric furnace of a type not too sluggish in its response to changes of power input, might be an advantage, and its use should at any rate make careful pyrometric control of pouring temperatures easier.

The General Electric Co. uses a small 75 kilowatt furnace like its older type of electric brass furnace, holding some 75 or 100 pounds of aluminum, to melt a nearly pure aluminum which must flow freely as it must run down through the slots in a motor rotor. This rotor casting is made in an ingenious centrifugal casting machine, and to secure the desired results, the temperature and fluidity of the metal and the speed of the centrifugal device must each be just right. The control over the metal made possible by the furnace, and the fact that the furnace itself is automatically operated is considered to make good results more certain and easy than would be possible with a fuel-fired furnace. This furnace has been in use over a year and a half without relining, the only difficulty being that the accretion of oxide in the hearth has cut down the hearth capacity. On account of the low pouring temperature of aluminum compared to brass or bronze, almost any type of electric brass furnace applied to aluminum should have little difficulty in maintaining the refractories.

The General Electric Co. also uses a larger furnace of the same type of about 800 pounds capacity, 150 kilowatts, for ordinary aluminum casting work. It has also designed a large

TABLE III

Electric Furnaces for Nonferrous Melting

Reflected Heat Furnaces

Make	No	User	Alloy	Capacity tons per heat per furnace	K.W. rating per furnace	Total K.W.	Remarks
Baily	1	Acheson Mfg. Co., Rankin, Pa.	brass and bronze	¾	105	105	
Baily	1	Akron Bronze and Aluminum Co., Akron, O.	brass and bronze	¾	105	105	
Baily	1	Akron Bronze and Aluminum Co., Akron, O.	brass and bronze	¼	50	50	
Baily	1	American Hardware Corp., New Britain, Conn.	brass and bronze	¾	105	105	
Baily	1	Anaconda Copper Mining Co., Butte, Mont.	brass and bronze	¾	105	105	
Baily	1	Atlas Brass Works, Columbus, O	brass and bronze	¾	105	105	
Baily	2	Buick Motor Car Co., Flint, Mich.	brass and bronze	¾	105	210	
Baily	2	Burlington Brass Wks., Burlington, Wis	brass and bronze	¾	105	210	
Baily	2	Capitol Brass Co., Detroit	brass and bronze	¾	105	210	
Baily	1	Coppus Engineering and Equipment Co., Worcester, Mass.	brass and bronze	¾	105	105	
Baily	1	Dayton Engineering Labs Co., Dayton, O.	Al	1/5	105	105	
Baily	2	Dayton Engineering Labs, Co., Dayton, O.	brass and bronze	¼	50	100	
Baily	1	Deming Co., Salem, O.	brass and bronze	¼	50	50	
Baily	3	Detroit Brass Wks., Detroit	brass	¾	105	315	
Baily	1	Drew Electric and Mfg. Co., Cleveland	brass and bronze	¾	105	105	
Baily	1	Hays Mfg. Co., Erie, Pa.	brass	¾	105	105	
Baily	1	Kayline Co., Cleveland, O.	brass and bronze	¼	50	50	
Baily	1	Kennedy Valve Co., Elmira, N. Y.	brass and bronze	¾	105	105	
Baily	1	Landers, Frary and Clark, New Britain, Conn.	aluminum	1/10	50	50	
Baily	2	Lumen Bearing Co., Buffalo, N. Y.	brass and bronze	¾	105	210	
Baily	1	Lumen Bearing Co., Buffalo, N. Y.	Lumen	½	105	105	

TABLE III—(continued)

Electric Furnaces for Nonferrous Melting

Reflected Heat Furnaces

Make	No.	User	Alloy	Capacity tons per heat per furnace	K W. rating per furnace	Total K W	Remarks
Baily	1	Miller Pasteurizing Machine Co., Canton, O	brass and bronze	1/4	50	50	
Baily	4	Michigan Smelting and Refining Co., Detroit	brass	3/4	105	420	
Baily	1	A. Y. McDonald Co., Dubuque, Ia	brass and bronze	3/4	105	105	
Baily	1	McKenna Brass Wks., Pittsburgh, Pa.	brass and bronze	3/4	105	105	
Baily	1	McKenna Brass Wks., Pittsburgh, Pa	brass and bronze	1/4	50	50	
Baily	3	McRae Roberts Co., Detroit	brass and bronze	3/4	105	315	
Baily	2	Nolte Brass Co., Springfield, O.	brass and bronze	3/4	105	210	
Baily	1	Ore Metals Co., Los Angeles, Calif	brass and bronze	3/4	105	105	
Baily	1	Penberthy Injector Co., Detroit	brass and bronze	3/4	105	105	
Baily	1	Regent Brass Works, Marysville, O.	brass and bronze	3/4	105	105	
Baily	1	Rundle Mfg. Co., Milwaukee, Wis.	brass and bronze	1/4	75	75	
Baily	5	Standard Sanitary Mfg. Co., Louisville, Ky	brass and bronze	3/4	105	525	
Baily	1	S. H. Thomson Mfg. Co., Dayton, O	brass and bronze	1/4	50	50	
Baily	1	Union Metals Mfg. Co., St. Paul, Minn	brass and bronze	3/4	105	105	
Baily	1	Union Screen Plate Co., Fitchburg, Mass	brass and bronze	1/2	75	75	
Baily	1*	U. S. Copper Products Co., Cleveland, O	brass	3/4	105	105	nose-tilting
Baily	1	U. S. Navy Yard, Washington, D. C.	brass and bronze	3/4	105	105	
Baily	1	Westinghouse Electric and Mfg. Co., E. Pittsburgh, Pa.	brass and bronze	1/4	50	50	
Baily	2	West Va. Metal Products Co., Fairmont, W. Va.					
Baily	1*	U. S. Copper Products Co., Cleveland, O.	brass	3/4	105	105	nose-tilting
Baily	1	U. S. Navy Yard, Washington, D. C.	brass and bronze	3/4	105	105	
Baily	1	Utica Valve and Fixture, Utica, N. Y.	brass and bronze	3/4	105	105	
Baily	1	Westinghouse Electric and Mfg. Co., E. Pittsburgh, Pa	brass and bronze	1/4	50	50	
Baily	2	West Va., Metal Products Co., Fairmont, W. Va.	brass and bronze	3/4	105	210	nose-tilting
Baily	1	White and Bros., Philadelphia	brass and bronze	3/4	105	105	
	65**					5950	
General Electric Co.	1	General Electric Co., Schenectady, N. Y.	aluminum	1/20	75	75	
General Electric Co.	1	General Electric Co., Schenectady, N. Y.	aluminum	2/5	150	150	
General Electric Co.	1	General Electric Co., Schenectady, N. Y	brass and bronze	1 1/4	400	400	
General Electric Co.	1	Ohio Brass Co., Mansfield, O.	brass and bronze	1 1/4	400	400	
General Electric Co.	1	U. S. Copper Products Co., Cleveland	brass and bronze	1 1/4	400	400	
General Electric Co.	1	U. S. Navy Yard, Washington	brass and bronze	1 1/4	400	400	
	6***					1825	

* Furnace soon to be moved to Parish-Pool Co., Cleveland.
** 48—105 K.W.; 2—75 K.W.; 10—50 K.W.; about 50 of these were already installed June 1.
*** 2 of these not yet installed.

furnace of the same general type, holding several tons which it hopes to try out experimentally. The design calls for a long, rather narrow hearth with a weir or a dividing wall with a hole in it, about half way up, between the two parts of the hearth. Metal is to be charged at the back, melted, and clean metal, free from dross floating on top, or from foreign particles heavier than the metal, is to run through into the fore part. The rate of melting in the rear part of the hearth and of superheating to pouring temperature in the fore part may be regulated by changing the position of the electrodes along the front or rear, to generate more or less power as desired. This scheme offers some possibilities, but they must be tried out before their value is certain.

The General Electric Co. is building still another type of electric aluminum furnace to be tried at the Pittsfield, Mass., plant This is a rectangular tilting furnace, like a long box, the hearth occupying the lower part, the heating element being strips of nickel-chromium resistance ribbon, such as is used in the heat-treating furnaces for gun-forgings.* The heating element is placed not only in the roof proper but also on the sides, above the hearth. Such a resistor will not stand operation at temperatures sufficient to melt brass, but it may handle aluminum at a repair cost that will not be prohibitive. One factor leading the General Electric Co. to build this type was a desire to secure comparative data on the effect of the oxidizing atmosphere this furnace will have against that of the reducing atmosphere in the arc-resistance type used both for brass and aluminum.

The General Electric arc-resistance furnaces for use on aluminum are the same as for brass, except that the transformer capacity and power input are lower for the same size shell, than on brass. They give the following table, for different sizes:

Kilowatts	Hearth capacity lbs.	Nominal lbs. melted per hour	Approx. kilowatt hours per ton
		On basis of 24 hour operation, i. e., after furnace is fully hot	
100	300	250	600
150	800	500	525
200	1000	750	500
300	1400	1200	500

One Baily standard 150 kilowatt furnace is operating regularly on No. 12 aluminum at the plant of the Dayton Engineering Laboratories Co., Dayton, O. A test run on the furnace showed an output of about 1½ tons per day in 8½ hours actual melting, plus 1 hour preheating the furnace or seven to eight heats of 425 pounds each. The average power consumption ran from 625 to 675 kilowatt hours per ton. The

*Johnson, L. F., How the power house aids the forge, Iron Trade Review, 1919, p. 1223.

average power input was only 80 kilowatts. Twenty-four-hour operation figures cannot be extrapolated from the data as reported. The users are well satisfied with the operation.

At the plant of Landers, Frary and Clark, New Britain, Conn., one of the 50 kilowatt rectangular Baily furnaces was operated for about two months before it was taken out on account of trouble in maintaining the resistor trough. It later was replaced by the round type of the same make. This furnace, melting 9 hours per day and being preheated 4 hours gave on 150-pound heats, gave an output of ½ ton per day, at 850 kilowatt hours per ton. The net metal loss was about 0.7 per cent.

One of the 150 kilowatt Baily furnaces was tried out some years ago by the Aluminum Co. of America for making ingot from pig aluminum, but was not kept in service, being considered too small for that type work.

A big 500 kilowatt tapping type Baily furnace later was installed at the plant of the United States Aluminum Co., Massena, N. Y. This has been described by Miller.* It had two straight resistors, one on each side of the hearth, and held 3 to 4 tons of aluminum. In this furnace, according to the users,** under best conditions and continuous operation the production was about 1 ton per hour at slightly under 500 kilowatt hours per ton. The furnace primarily was installed for making alloys high in zinc, and on such service it showed a notable decrease in metal loss over fuel-fired reverberatory furnaces. However, on the regular run of aluminum there was no decrease in metal loss. The resistor troughs have been a source of trouble, failing frequently, and the high heat capacity of the furnace makes it less efficient on intermittent operation, the power consumption averaging some 700 kilowatt hours per ton on the furnace as actually operated over a period of time.

As a consequence of the high power consumption the use of the furnace has been practically given up, and its owners contemplate changing it over to an annealing furnace, since such furnaces give satisfactory results at the lower operating temperatures used in annealing.

It should be mentioned that a 105-kilowatt Baily furnace long has been in satisfactory operation at the Lumen Bearing Co., Buffalo, on an alloy of

*Miller, D. D., The remelting of aluminum pig in the electric furnace, Chem. and Met. Eng., Vol. 19, 1918, p. 251.

**Vail, A. E., personal communication, Jan. 21, 1920.

TABLE V
Electric Furnaces for Nonferrous Melting
Contact Resistance Furnaces

Make	No	User	Alloy	Capacity tons per heat per furnace	K.W. rating per furnace	Total K.W.
Bennett	6	Scovill Mfg. Co., Waterbury, Conn	brass and copper	1	150	900
Bennett	1	Scovill Mfg. Co., Waterbury, Conn.	brass and copper	5	500	500
	7					1400

Crucible Furnaces

Make	No	User	Alloy	Capacity tons per heat per furnace	K.W. rating per furnace	Total K.W.
Baily	1	W. A. Rogers Ltd., Niagara Falls	silver	about 65 Lbs	40	40
Ajax Northrup	1	Baker and Co., Inc., Newark, N. J.	platinum	.	20	20
Ajax Northrup	1	J. R. Wood and Sons New York City	gold	...	20?	20
Ajax Northrup	2	U. S. Mint, Philadelphia	gold and silver	about 75 Lbs	8	16
Ajax Northrup	2	U. S. Mint, Philadelphia	gold and silver	about 190 Lbs.	16	32
Ajax Northrup (tilting)	1	Handy and Harmon, Bridgeport, Conn	silver	600 Lbs	60	60
	8					188

TABLE IV
Electric Furnaces for Nonferrous Melting
Vertical Ring Induction Furnaces

Make	No	User	Alloy	Capacity tons per heat per furnace	K.W. rating per furnace	Total K.W.
Ajax-Wyatt	3	Ajax-Metal Co., Philadelphia	yellow brass	1/6	30	90
Ajax-Wyatt	32*	American Brass Co., Waterbury, Conn	yellow brass	1/3	60	1920
Ajax-Wyatt	24**	American Brass Co., Torrington, Conn	yellow brass	1/3	60	1440
Ajax-Wyatt	24	American Brass Co., Kenosha, Wis.	yellow brass	1/3	60	1440
Ajax-Wyatt	1	American Hardware Co., New Britain, Conn	yellow and red	1/6	30	30
Ajax-Wyatt	6	Baltimore Tube Co., Baltimore, Md	yellow brass	1/3	60	360
Ajax-Wyatt	24	Bridgeport Brass Co., Bridgeport, Conn	yellow brass	1/4	60	1440
Ajax-Wyatt	21***	Bridgeport Brass Co., Bridgeport, Conn	yellow brass	3/4	80	1680
Ajax-Wyatt	1	Buick Motor Car Co., Flint, Mich.	yellow brass	1/3	60	60
Ajax-Wyatt	31****	Chase Rolling Mill Co., Waterbury, Conn	yellow brass	1/3	60	1860
Ajax-Wyatt	1	General Electric Co., Schenectady, N. Y.	yellow brass	1/3	60	60
Ajax-Wyatt	6	National Conduit and Cable Co., Hastings, N. Y.	yellow brass	1/3	60	360
Ajax-Wyatt	1	Raritan Copper Works, Raritan, N. J.	yellow brass	1/3	60	60
Ajax-Wyatt	1	Parish-Pool Co., Cleveland, O	yellow brass	1/3	60	60
Ajax-Wyatt	1	Rome Brass and Copper Co., Rome, N. Y.	yellow brass	1/3	60	60
Ajax-Wyatt	1	Scovill Mfg. Co., Waterbury, Conn.	yellow brass	1/4	60	60
Ajax-Wyatt	1	Stamford Rolling Mills Co., Stamford, Ct	yellow brass	1/3	60	60
Ajax-Wyatt	1	W. A. Clark Wire Co., Bayway, N. J.	yellow brass	1/3	60	60
Ajax-Wyatt	6	West Va. Metal Products Co., Fairmont, W. Va.	yellow brass	1/3	60	360
Ajax-Wyatt	1	U. S. Navy Yard, Washington, D. C.	yellow brass	1/3	60	60
	187*****					11520

* Including 16 not installed but planned for.
** Not yet installed but planned for.
*** Only one of these is yet installed. The 20 planned for is approximate
**** Only one of these is yet installed.
***** Only 93 of these are yet installed.

Horizontal Ring Induction Furnaces

	No	User	Alloy	Capacity	K.W.	Total K.W.
	1	Hoskins Mfg. Co., Detroit	nickel alloys	1/6	100	100

approximately 85 per cent zinc, 10 per cent copper, 5 per cent aluminum, which is poured at about 700 degrees Cent. The furnace gives about 5500 pounds per 10-hour melting day, using about 660 kilowatt hours in the daytime and 330 at night to keep the furnace hot, *i.e.*, about 360 kilowatt hours per ton on this low-melting alloy.

A few isolated heats of aluminum have been made in Snyder direct arc furnaces, but no data of consequence appear to have been kept, and none are available. If the direct arc furnace will produce a satisfactory quality of metal, without undue gas absorption in the overheated metal under the arc, such a furnace should work well, since the common aluminum alloys, outside of the zinc-containing alloys, are relatively nonvolatile, and direct arc furnaces are useful for such alloys. This question should be investigated, and the bureau of mines hopes to study it.

The Rennerfelt indirect arc furnace in a small 50 kilowatt size was used in making up the hardeners used by the Aciéral Co. of America, but not in melting the aluminum alloy itself, before that firm went out of business. Similar hardeners now are handled in a similar furnace, but of 100 kilowatt capacity at the Bausch Machine Tool Co., Springfield, Mass. No real tests of stationary indirect arc furnaces on aluminum alloys themselves are on record. However, on the basis of some small test runs in the 50 kilowatt furnace, made by starting with the furnace at the temperature used for making hardeners, and therefore well above aluminum temperatures, it was calculated that in a 1-ton furnace 310 kilowatt hours would be required, presumably on 24-hour operation. These figures later were revised to 350, but neither figure is based on adequate test.

One of the standard Detroit rocking furnaces rated at 300 kilowatts was given a thinner lining than for use on brass, the melting chamber being 49 inches diameter by 41 inches, the furnace thus lined holding 1700 pounds of aluminum, and tested at the C. B. Bohn Foundry Co., Detroit. The power input was raised to 325-375 kilowatts, and on about 60 tons of No. 12 the actual melting time averaged about 1 hour, 10 minutes per heat, corresponding to an output of about 5 tons per 10-hour day, at about 475 kilowatt hours per ton. The 24-hour melting rate would approach 375 kilowatt hours per ton. The net metal loss averaged about 0.85 per cent, running about 0.45 per cent on American ingot, scrap No. 12 and gates, and up to 1.3 per cent on some French ingot that appeared to contain some nonmetallic impurities that weighed in as metal, though it is also possible that there was in this case some formation of aluminum carbide due to piling the charge too close to the arc in the runs on French metal which were made first. The product from both the French and American metal was of satisfactory quality. The furnace is used for making up the copper-aluminum hardener, as well as for No. 12 alloy.

TABLE VI
Furnaces for Nonferrous Melting
Totals by Types

Type	Make	Approx. No actually installed June	Approx. No. actually installed for copper, brass and bronze	Total No including those being installed and on order June 1	Total capacity of all per heat Tons	Total No. for copper, brass and bronze	Total K.W.H. of all
Direct arc	Heroult Snyder Greaves-Etchell	11	2	11	7½	2	3500
Stationary Indirect Arc	Rennerfelt	7	6	7	4½	6	1375
Moving Indirect Arc	Detroit	40	39	50	46	49	13800
Moving Indirect Arc	Booth	10 (est)	10 (est)	35	9	15	4720
Moving Indirect Arc	American	1	1	1	½	1	300
Reflected heat	Baily	50	47	65	41½	57	5950
Reflected heat	General Electric	4	4	6 or more	5½	4	1825
Induction Vertical Ring	Ajax Wyatt	93	93	187	70½	187	11520
Horizontal Ring Induct.	Hoskins	1	0	1	⅛	0	100
Contact Resistance	Bennett	7	7	7	11	7	1400
Crucible	Ajax-Northrup and Baily	7	0	8	under ½	0	188
Ni-Cr Resistor for aluminum	General Electric	0	0	1	⅛ (est)	0	100 (est)
		231	209	379	196¾	348	44858

The Ajax-Wyatt induction furnace has not been tried on aluminum.

It will be noted that all the data on aluminum shows a high power consumption per ton of metal compared to that required by the same furnace on brass. The figures range on 10-hour operation from 850 kilowatt hours per ton in the 50-kilowatt Baily on 150-pound heats through 650 kilowatt hours per ton in the 105-kilowatt Baily on 425-pound heats, to 475 kilowatt hours per ton in the 375 kilowatt Detroit on 1700-pound heats. The 24-hour operation figures for the 3 to 4-ton Baily tapping furnace and for the 1000 to 1400-pound General Electric furnaces, are 500 kilowatt hours per ton, under best conditions. Roughly, a given size and type of furnace requires at least 50 per cent more power per ton to heat aluminum to 700 degrees Cent. than it does yellow brass to 1050 degrees Cent.

In fact, theory calls for the expenditure of about twice as much energy, since, averaging the available data, 100 per cent melting efficiency calls for about 150 kilowatt hours per ton for yellow brass,* and about 300 kilowatt hours per ton for No. 12 aluminum.

In fuel-fired furnaces, the difference in fuel consumption is not so marked because such furnaces operate at a higher efficiency the lower the temperature, so that a given fuel-fired furnace probably can produce a ton of aluminum with not much more fuel than it would use on yellow brass.

Without the savings in metal losses and in crucibles shown in brass melting, without definite proof of improved quality of metal, the value of electric furnaces for aluminum depends primarily on whether or not an aluminum melter can pay around $7 to 10 or more per ton, depending on the cost of power and the size and type of electric furnace chosen, for electric power to melt his metal, plus the interest and depreciation charges per ton on an ex-

*Compare Richards, J. W., Electric Power Required to Melt Metals, Trans. Am. Brass Founder's Assn., Vol. 4, 1910, p. 95; Clamer, G. H., and Hering, C., The Electric Furnace for Brass Melting, Trans. Am. Inst. Metals, Vol. 6, 1912, p. 101; Hansen, C. A., Electric Melting of Copper and Brass, Trans. Am. Inst. Metals, Vol. 6, 1912, p. 112. Also unpublished data from Bridgeport Brass Company.

pensive furnace which will give only a small output, compared to brass, of the light metal, aluminum, and still beat his present fuel costs.

The various electric furnaces for melting nonferrous metals now in use and being developed have been described, though many early ones that fell by the wayside, through whose failure much has been learned, have not been included. It is of interest to see how many furnaces, and of what types, are among the live ones in the United States, and the accompanying tables, which include only those furnaces that can fairly be said to be in actual operation or which are on definite order or definitely planned for by the management of a plant and are so reported by the plant, therefore has been prepared. Smelting rather than melting furnaces, of which there are a few on nonferrous work, to say nothing of the electrolytic cells used in the production of aluminum, are not included.

The tables show that on June 1, 1920, there were actually installed and regularly operating about 210 electric brass furnaces and some 20 other nonferrous electric furnaces, taking a total of over 30,000 kilowatts, *i.e.*, equivalent to about a third the total generating capacity of the famous Connor's creek generating station of the Detroit Edison Co.

Around 170 more furnaces were on order or definitely planned, and while adverse business conditions may postpone some of the installations, especially the large installations of Ajax-Wyatt furnaces contemplated by three rolling mill firms, yet most of these are expected to go in eventually. If one cared to add to the total by including small furnaces used intermittently for laboratory work, those for demonstration purposes, and the various experimental furnaces under more or less active development, he might state that in 1920, nonferrous alloys probably will be melted in about 400 different electric furnaces. The natural growth of electric brass melting may really bring it to that figure.

It is quite certain that the end of 1920 will see in commercial operation more electric brass furnaces in the United States than electric steel furnaces. By that time the power used in electric brass melting will be well over 10 per cent of the electric power used by the city of Detroit, and the foundrymen of the United States will have invested around $2,500,000 in electric brass furnaces.

When all these furnaces are in operation, they may be expected to use roughly 100,000,000 kilowatt hours per year, which will cost, roughly $1,000,000. They should produce roughly 250,000 to 333,000 tons of metal, or say a third to a half of the total amount melted. All these calculations depend on whether the furnaces are run 24 hours a day or only eight to 10 hours, and on many other factors, but they serve at least to show the order of magnitude.

TABLE VII

Furnaces for Nonferrous Melting

Other Electric Brass and Aluminum Furnaces being Developed

Name	Type	Inventor or Developer
Foley Rennerfelt Reverberatory	Vertical Ring Induction Reflected Heat	C B Foley—Bristol Brass Co., Bristol, Conn. H. A. DeFries—Hamilton and Hansel, Inc., Park Row Building, N. Y. City.
Thomson	Moving, zig-zag solid resistor	John Thomson, 253 Broadway, N. Y. City.
Industrial	Not known, 3-phase self regulating phase	Industrial Electric Furnace Co., 53 W. Jackson Blvd, Chicago, Ill.
Moore	Moving indirect Arc	Pittsburgh Electric Furnace Corp., Union Bank Bldg, Pittsburgh, Pa.
Reardon	Moving indirect Arc (converter open flame oil furnace)	W. J. Reardon, Aluminum Manufacturers, Inc, Detroit, Mich.
General Electric Co.	Nickel-chromium resistor furnace for aluminum	E. I Collins, General Electric Co., Schenectady, N. Y.
Stassano-Petinot	Stationary Indirect Arc	N. Petinot, U. S. Ferro Alloys Corp., 30 E. 42nd St, N. Y. City.

Total different types or makes of electric furnaces for nonferrous metal in commercial use in the United States . . . 14
Total other types or makes being developed 8
Total distinct types or makes suggested or tried for nonferrous melting, over 80

Furnaces Sold to Foreign Countries by United States Makers

Make	Firm	Location	Alloys Melted
Heroult	Hiram Walker Metal Products Co.	Walkerville, Ont, Canada	Nickel alloys
Greaves-Etchell	Government Mint	Japan	Bronze and silver
(Electric Furnace Construction Co, Phila.)	Lacheze et Fils	Dijon, France	Non-ferrous
Baily	G. Amsinck Corp.	Mexico City, Mexico	Brass and bronze (2-105 K.W. each furnaces)
Baily	Dominion Steel Products Co.	Brantford, Ont., Canada	Brass and bronze (50 K.W.)
Baily	Mitsui and Co.	Japan	Brass and bronze (105 K.W.)
Baily	Allen and Everett	Birmingham, Eng.	Brass and bronze (105 K.W.)
Detroit	Furakawa Mining Co.	Japan	Brass and bronze (75 K.W.)
Detroit	Kobe Steel Co.	Japan	Brass and bronze (105 K.W.)
Detroit	Mitsubishi Co.	Japan	Brass and bronze (75 K.W.)
Detroit	Schneider & Co.,	Creusot, France	Brass and bronze (105 K.W.)

Total nonferrous electric furnaces of United States make sold for use in other countries 12

Number plants in U. S. employing or having ordered electric furnaces for nonferrous melting 118

Number of plants in U. S. employing 2 or more electric furnaces for nonferrous melting 40

Number plants in U. S. employing 2 or more different types or makes of electric furnace for commercial nonferrous melting 16

Approximate number of nonferrous electric furnaces made abroad and used abroad, mostly Rennerfelts—about 30

With 50 per cent more furnaces in actual operation than its nearest competitor and being scheduled to make up 50 per cent of the total number of all furnaces installed, the Ajax-Wyatt furnace leads in numbers, and may be fairly said to have revolutionized melting methods in the wrought brass industry. The Detroit rocking furnace leads in total kilowatts connected, and in output as well, though, as most of that type operate but 10 hours while the Ajax-Wyatt operates 24, the latter closely approaches the Detroit in output now, and will surpass it when all the Ajaxes planned for are in operation. The Baily furnace is second in numbers and is close in connected kilowatts to the present actually installed Ajaxes, but in total production is behind the Detroit and the Ajax. The Booth furnace is climbing steadily.

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Expanding Foreign Service

TO PROVIDE larger and better facilities of a permanent character for the growing requirements of our European division, the London office of THE FOUNDRY will be moved on July 1 from 16 Regent street to 2-4 Caxton House, Westminster, London, S. W. 1. Correspondence for our European office should be addressed to Caxton House hereafter, together with that for the affiliated publications of The Penton Publishing Co., which include the *Daily Iron Trade and Metal Market Report, The Iron Trade Review, Marine Review, Power Boating* and *Abrasive Industry*.

As a result of this change, greatly improved facilities will be provided for transacting all of the European business of THE FOUNDRY. Caxton House, which is one of the leading modern office buildings in London, is located in the heart of the Westminster iron, steel, marine and engineering district. It is within a block of the headquarters of the British Iron and Steel institute, Institution of Mechanical Engineers, Institution of Civil Engineers, Institute of Metals, etc. Within a short distance also are located the houses of parliament, British government offices, and the offices of many of the largest iron, steel, shipbuilding and engineering firms in Great Britain, together with the European offices of many large American iron, steel and machinery corporations.

American business men traveling to England are cordially invited to make their headquarters at our London offices. During the coming summer season special facilities will be available for taking care of mail, which may be addressed in care of our European headquarters. Other arrangements are being made to look after the requirements of business visitors and we hope this will be considered as a personal invitation by any of our readers, friends or advertisers who may be going abroad.

What Is Good Coke

ALTHOUGH coke is one of the most essential items entering into casting production, foundrymen generally have given it little consideration from a technical standpoint. Of course, the practical foundryman knows in his own case which of the available products gives the best results, but does he know whether it would be possible to improve on his favorite fuel or whether some new coke would not give still better results in his cupola? The question of foundry coke, considered from the manufacturing end has been treated in the literature of the past few years, but there has been a marked absence of anything of a scientific nature describing the coke which should be used in the foundry to produce the best results. So far, practically all that has been done in this connection has been fostered by the coke producers themselves. Of course, a wide range of size and composition in coke may be possible without materially affecting the results in the cupola, but if this is so, it should be known and tested by the foundryman and not left to the coke producer. In a paper appearing in this issue, the author, who is engineer for a coke company, shows something of what is being done to improve the nature and quality of foundry coke, but he is frank to admit that he does not know just what will produce the best results in the foundry. Undoubtedly, thought should be given to this question for coke companies have shown themselves eager in the past to assist.

Trade Outlook in the Foundry Industry

COKE scarcity will become more acute during the late summer, fall and winter. This is the composite expression of opinion voiced both by producers and large users of this fuel. At present the foundryman who is receiving 50 per cent of his contract allotment of coke is favored. With a continuing and aggravated car shortage, 50 per cent is an outside estimate of the cars available for coke shipment, and road delays enroute still continue in many sections. Therefore, that foundry which is receiving one-half of its normal requirements is fortunate.

Market Is Wild

The acute scarcity which impends has driven coke prices steadily upward. Spot foundry coke is quoted at $15 to $17 ovens, and some has been sold at above $20 a ton. July 1, which marks the termination of the first half contracts for coke finds few stable agreements for last half delivery. Users, in general, share with producers a reluctance to enter into contracts covering the entire six months. A number of sales have been made for last half coke, based upon a sliding scale which in turn rests upon advancing coal prices. At a season when, ordinarily, foundries would be secure as to price and delivery for the fall and winter, and when a reserve against winter traffic delays would be well established, little activity is noted. While shops in general have been able to maintain a day-to-day supply of fuel, no surplus is to be had. Anxiety regarding supplies of iron and coke, has led foundrymen to neglect sand, in some instances. Preferential distribution of cars, has not taken into account the essential character of molding sand. Consequently traffic committees representing foundries in some of the larger centers are acting to secure shipment on at least a small reserve of sand before the winter.

Prices of Raw Materials for Foundry Use

CORRECTED TO JUNE 25

Iron		Scrap	
No. 2 Foundry, Valley	$44.00	Heavy melting steel, Valley.....	$25 00 to 26.00
No. 2 Southern, Birmingham..	40.00 to 42.00	Heavy melting steel, Pittsburgh..	25.50 to 26.00
No. 2 Foundry, Chicago.......	44 00 to 45 00	Heavy melting steel, Chicago...	23.00 to 23 50
No. 2 Foundry, Philadelphia ...	45.60 to 48.10	Stove plate, Chicago	31.50 to 32 50
Basic, Valley	44.50 to 45.00	No 1 cast, Chicago..	41.00 to 41 50
Malleable, Chicago	43.50	No 1 cast, Philadelphia	37 00 to 39 00
Malleable, Buffalo	46.25	No. 1 cast, Birmingham	30.00 to 33.00
		Car wheels, iron, Pittsburgh....	38.00 to 39 00
Coke		Car wheels, iron, Chicago.. ...	35.50 to 36 00
Connellsville foundry coke......	15.00 to 17 00	Railroad malleable, Chicago.....	28.75 to 29 25
Wise county foundry coke......	12.00 to 12.50	Agricultural malleable, Chicago..	28.50 to 29 00

Conservation Imperative

Many foundries at present are melting with a low ratio of coke to iron established in the days when coke was $6 per ton, and when a few hundred weight of fuel per charge made little impression upon the per pound cost of castings. With increasing coke prices, the same ratio has been maintained, many regarding the extra cost as a premium on insurance against dull iron. The problem now has passed beyond a matter of unit cost of castings. Coke production is decreasing week by week. Scanty supplies of cars in which to ship from the ovens have been still further restricted through a recent order of the interstate commerce commission which provides that coal cars must be used exclusively for coal, and may not be reloaded with coke at the ovens. This will further restrict coke output. Therefore, disregarding the cost factor, a longer melting ratio must obtain if gray-iron castings production is not to suffer a severe contraction. Where 4 to 1 charges have been used, 8 to 1 or even 10 or 12 to 1 should be adopted if the class of work handled will permit this conservation. Those who are receiving coke shipped within the past 30 or 60 days report a great deterioration in quality. The ash content which normally does not exceed 6 per cent has mounted to 12 to 14 per cent. Sulphur is high, and the amount of breeze and fine material is immeasurably increased. The reason for these shortcomings in the fuel is directly traceable to the car shortage. The former 72-hour by-product coke is practically unknown at present. When cars are available, the ovens are pushed at from 40 to 50 hours after they are charged, in order that the tracks may be cleared and new cars placed as quickly as they become available. On the other hand, when no cars are available, the coke time must necessarily be extended, as only a small amount of storage space is available. This produces an inferior quality of coke which is easily broken down in handling. Beehive producers although faced by different problems, are hampered by shortage of cars in a similar degree. Although few cancellations have been received, a marked slackening in demand for gray iron castings is noted. This condition is not taken to indicate the approach of over production, but rather a temporary lull induced by transportation difficulties experienced by the large users of castings. Many foundries continue to have difficulty in shipping their finished product, through inability to secure cars, although when once loaded, transportation to destination is fairly satisfactory.

Costs Block Construction

Curtailment of building activities, due to high prices, has lessened the demand for plumbing goods and other domestic castings. Cast iron pipe also, is not active, due to the inability of municipalities to finance new undertakings. The production schedules of passenger automobile manufacturers has been slightly abridged. It is hoped that the output may not fall below 65 per cent of the early 1920 estimates, but a cut of at least 35 per cent is expected. Tractor and truck building companies have not been obliged to curtail their programs, although at present some difficulty is experienced in securing materials. Prices of nonferrous metals based on New York quotations follow: Copper, 17.62½c to 17.75c; lead, 8.50c; tin, low: Copper, 17.62½c to 17.75c; lead, 8.50c; tin, 46.25c to 46.50c; antimony, 7.50c to 7.62½c; aluminum, No. 12 alloy, producers' price, 32.00c and open market, 31.00c. Zinc is quoted at 7.40c to 7.45c, St. Louis.

Comings and Goings of Foundrymen

JAMES A. GALLIGAN, sales agent for Pickands, Brown & Co., Chicago, for the past 12 years, has been appointed sales manager and assistant to Vice President C. D. Caldwell of the By-Products Coke Corp. at Chicago. The sale of coke by Pickands, Brown & Co., which has been in his charge, has been assumed by R. S. Dutton, manager of sales for all departments. F. L. Schulze has been appointed assistant sales agent for the coke department. Mr. Galligan's experience of 12 years in selling the output of the western coke plants has given him wide insight into the production and distribution of coke, a fact recognized when he was appointed in April, 1918, as district representative in charge of coke distribution in the Middle West under the United States fuel administration. In this position he allocated the output of all plants in Indiana, Illinois, Wisconsin and Missouri. Mr. Galligan is a native of Milwaukee and is 45 years of age. He began his business career at 16 years as a stenographer and in 1899 entered the employment of the Edward P. Allis Co., Milwaukee. Two years later was made manager of the Elizabeth Mining Co. in the Black Hills, which was owned by Mr. Allis. In 1902 he joined the staff of the Allis Chalmers Co., Milwaukee, advancing to assistant general purchasing agent. In 1906 he became salesman for Pickands, Brown & Co., in their Milwaukee office, being transferred to their Chicago office two years later to have charge of coke sales.

G. W. Price, formerly superintendent of the gray iron and steel foundries of the Lenoir City Car Works, Lenoir City, Tenn., has been appointed superintendent of the gray iron and steel foundries operated by the Anniston Steel Co., Anniston, Ala.

C. D. Gilpin now is works manager of the Detroit plants of the Aluminum Manufactures, Inc., Cleveland. He has been with the company about eight years, commencing as timekeeper.

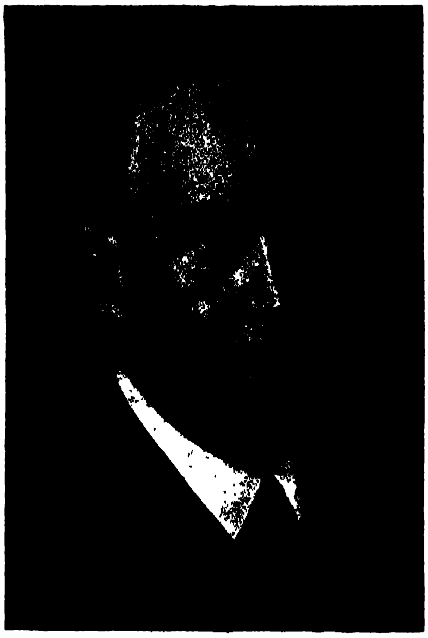
James Anderson recently assistant foundry foreman of the Morgan Engineering Co., Alliance, O., has been made assistant superintendent for the Edgewater Steel Corp., Oakmont, Pa.

W. E. Warner, who for a number of years has been associated with the Lumen Bearing Co., Buffalo, has been made superintendent of the new plant of that company at Youngstown, O.

C. S. Siebert recently has been appointed district sales manager in Cincinnati for the Iron Trade Products Co., Pittsburgh.

T. E. Malone, J. S. McCormick Co., Pittsburgh, has resumed his duties with this company after an absence of several months owing to ill health.

G. A. Weisgerber has been promoted to the position of purchasing agent



JAMES A. GALLIGAN

of Stanley G. Flagg & Co., Philadelphia, to succeed J. M. Mather, who recently resigned his position to engage in other activities.

Edward C. Waldvogel, who for the past four years has been general manager in charge of sales and advertising for the Yale & Towne Mfg. Co., has been elected on the directorate of that organization.

E. H. Williams, who recently resigned as a colonel from the United States army, has been appointed manager of service and inspection departments of the Valley Mould & Iron Corp., Sharpesville, Pa.

Fred Thornley, director and works manager, W. Thornley & Sons, Ltd., Sydney, Australia, is visiting this country to purchase equipment and supplies for his company's newly completed foundry. Mr. Thornley, until Aug. 1, will be located at the Highland Court Hotel Hartford, Conn.

E. F. Stone recently has resigned his position with the Medicine Hat Pump & Brass Co. to become foundry foreman for the Coppus Engineering Co., Worcester, Mass., manufacturer of steam turbines.

Alton N. Bates, vice president and general manager of the Erie Foundry Co., Erie, Pa., will return shortly from an extensive trip to England, France and Italy. He has been abroad for the past three months in the interest of his concern.

A. F. Stirling Blackwood recently resigned his position as vice president, general manager and director of the Union Steel Casting Co., Boston. Mr. Blackwood has organized a company to make steel castings utilizing a new type of melting furnace.

George P. Mills, formerly electrical sales engineer for the General Electric Co., Philadelphia, has been placed in charge of a department established to develop electrical heating furnaces for industrial use, by the Electric Furnace Construction Co., Philadelphia.

Willard A. Case recently has been elected treasurer succeeding John B. Milliken, who resigned his office as treasurer of the Yale & Towne Mfg. Co., Stamford, Conn. Mr. Case recently has been advisory engineer to the Audit Co., New York, which specializes in problems of operating management and accounting.

J. M. Mather has resigned as purchasing agent of Stanely G. Flagg & Co., Philadelphia and Pottstown, Pa., to become connected with the purchasing departments of the Central Foundry Co., 90 West street, New York, which also handles the sales of the pig iron output of the Central Foundry Co.'s southern furnaces.

Keith A. Wood, Malden, Mass., formerly New England district man- of electric industrial tractors, has been appointed manager of the electric truck division of the Cowan Truck Co., Holyoke, Mass. I. T. Hughes, who has represented the Cowan Truck Co. in New York state, has been promoted to sales manager of the hand truck division.

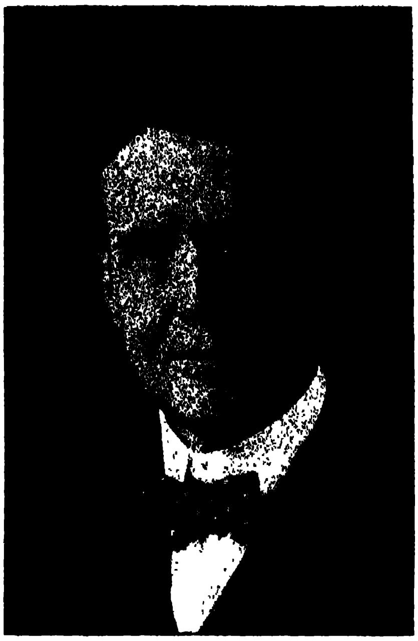
Allan F. Goodhue recently has been elected vice president in charge of sales for the Chicago Pneumatic

Tool Co., Chicago. Since May 1. 1919, Mr. Goodhue has been managing director of the company's English subsidiary, the Consolidated Pneumatic Tool Co., London, and also director of European sales for the Chicago company. Mr. Goodhue formerly was with the Midvale Steel Co. and Midvale Steel & Ordnance Co. in Philadelphia, Chicago and Boston. During the war he was assistant manager of the steel and raw material section, production division, of the Emergency Fleet Corp.

R. A. Sleicher, formerly vice president of the Edward A. Cassidy Co., New York, and prior to his affiliation with that corporation, vice president of the Troy Foundry & Machine Co., Troy, N. Y., has been appointed general manager of the Standard Process Steel Corp., Phillipsburg, N. J. The manufacture of steel castings at this plant has been discontinued and the entire facilities of the shop now are devoted to the production of both light and heavy gray iron castings. Equipment also is provided for machining the castings produced. A large number of molding machines now are being installed for the production of light work.

Hold Joint Meeting

At the invitation of the Connecticut Foundrymen's association, the New England Foundrymen's association met with it in joint session at Hotel Garde, Hartford, Conn., recently. The former association is less than a year old and the joint meeting therefore is the first of its kind. J. E. Stickler, president of the Connecticut association opened the session with a welcome to the members of the larger organization. He gave a brief description of the work and scope of the Connecticut association. The New England association is purely a social affair and the Connecticut foundrymen feeling a need for some combined effort to meet the many problems which arise in their industry, organized the Connecticut Foundrymen's association in June, 1919. The meetings of this association are conducted as open forums for the discussions of any topics pertinent to the business of manufacturing castings. Interest in the new association is active and over 80 per cent of the membership has been present at every meeting throughout the past year. Mr. Stickler said he felt that similar associations should be formed in Massachusetts and Rhode Island and that the three should be affiliated and co-ordinated in a revised New England Foundrymen's association. The principal paper of the evening was that of Thomas Kelly, manager of the Hartford County Manufacturers association. He described the association's work and told of the healthy condition of manufacturing plants throughout the Hartford district. Clifford Lovell, of Walker-Pratt Manufacturing Co. and vice-president of the New England Foundrymen's association spoke in behalf of the president and of the association members and thanked the Connecticut foundrymen for their hospitality. Other speakers were Robert E. Newcomb, former president of the New England Foundrymen's association and F. B. Farnsworth, of the McLagon Foundry Co. New Haven, Conn.



ALLAN S. BIXBY

Pittsburgh Foundrymen Observe Field Day

Combined with the annual outing and ladies' day of the Pittsburgh Foundrymen's association held at The Pines, Monday, June 21, was the installation of officers for the 1920-1921 term. A series of athletic events added to the gaiety of the occasion and the annual baseball contest between the foundrymen and supplymen was decided in favor of the former.

"Co-operation" was the subject of a forceful and instructive address delivered by George D. McIlvaine, of Pittsburgh. He directed attention to the co-operative spirit among business men engendered by the prosecution of the war and pointed out the need for legislation that will permit the continuation of such co-operative effort without danger of violating existing statutes governing combinations.

The following officers were installed: President, A. J. Hartman, United Engineering & Foundry Co.; vice president, F. H. Clay, Allegheny Steel Co.; treasurer, William J. Brant and secretary, Bayard Phillips, Phillips & McLaren Co.

The executive committee for the ensuing year are: A. M. Fulton; John Field, Union Steel Casting Co.; John W. Gray, Fort Pitt Steel Casting Co.; J. S. McCormick, J. S. McCormick Co., and H. P. Spilker, Sterret-Thomas Foundry Co. Foundry fund trustees are W. J. Brant.; C. H. Gale, Pennsylvania Malleable Co. and J. Lloyd Uhler, Union Steel Casting Co.

The following committee was in charge of the outing: A. C. Dobson, Carborundum Co.; G. A. Bauman, Jones & Laughlin Steel Co.; C. L. Kirk, Kirk Supply Co. and L. W. Mesta, Mesta Machine Co.

Obituary

Allan S. Bixby, manager of the Indianapolis plant of the National Malleable Castings Co., Cleveland, and prominent in the malleable castings industry, died at his home in Indianapolis, June 12, aged 50 years. The immediate cause of death was meningitis which had followed an attack of bronchial pneumonia extending over several weeks. Mr. Bixby was born in Philadelphia in 1870 and was graduated from the Rose Polytechnic institute in 1892. He immediately became connected with the Ewart Mfg. Co., of Indianapolis, now known as the Link-Belt Co.

He eventually became superintendent of the Ewart company. In 1902 he became associated with the National Malleable Castings Co., as superintendent of the Indianapolis plant, and in July, 1916, was made manager, which position he occupied at the time of his death. Mr. Bixby was a member of the Indianapolis chamber of commerce and several Indianapolis clubs. For some years he was a member of the industries committee of the Indianapolis chamber of commerce.

Whitfield P. Pressinger, New York, vice president, Chicago Pneumatic Tool Co., Chicago, who has been actively engaged in the pneumatic tool and allied machinery industry for many years, died recently. Mr. Pressinger was general manager of the Clayton Air Compressor Co. and was widely known through his activities in the various engineering societies.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The plant of the Dallas City Foundry Co., Dallas City, Ill., recently was damaged by fire.

The Woods Evarts Stove Co., Springfield, Mo., contemplates the erection of an addition to its plant.

The Buckley Foundry Co., Springfield, Mass., plans the erection of a foundry, 85 x 100 feet.

The Eastern Foundry & Machine Co., Philadelphia, plans the erection of a plant, 60 x 120 feet.

The Turner Mfg. Co., Ft. Washington, Wis., contemplates the erection of a foundry.

The Driver-Harris Co., Harrison, N. J., will erect a number of additions including a foundry building.

Plans are being prepared for the erection of a foundry for the Ohio Brass Co., Mansfield, O.

Fire recently damaged the plant of the Foundry Mfg. Co., St. Albans, Vt.

Plans have been drawn for the erection of a pattern shop, two stories, 18 x 76 feet, for the Ideal Pattern Works, Lockland, O.

The capital stock of the Western Foundry & Mfg. Co., Springfield, O., recently was increased from $1000 to $30,000.

The Atlantic Foundry Co., Akron, O., has increased its capital stock from $500,000 to $1,000,000.

The Parker Pattern Works Co., Springfield, O., recently was incorporated with a capital of $25,000, by W. T. Parker, E. D. Parker and others.

The capital stock of the Lansing Foundry Co., Lansing, Mich., recently was increased from $150,000 to $350,000.

The Perfection Mfg. Co., Minneapolis, of which J. Morck is vice president, contemplates the erection of a foundry, 30 x 90 feet.

The N. K. Foundry Co., Brooklyn, O., recently was chartered with a capital of $1000, by A. R. Marsh, H. L. Burkdull, F. S. Witcomb and others.

The Duval Foundries, Jacksonville, Fla., recently was incorporated with a capital stock of $10,000, by A. T. Hill, C. J. Eppert and S. W. Hornibrook.

The Springfield Malleable Iron Co., Springfield, O., plans the erection of two factory buildings, both to be two stories, 30 x 50 feet.

The Fritzell Foundry Co., New Haven, Conn., recently was incorporated with a capital of $100,000, by O. Y. Fritzell, G. Fritzell and A. G. Anderson.

The United States Electric Co., New London, Conn., has let a contract for the erection of a foundry, 75 x 100 feet.

Plans have been completed by the Oswego Foundry Co., Oswego, N. Y., for the erection of an addition to its plant, two stories, 50 x 100 feet.

Contracts have been awarded by the Modern Welding & Machine Co., Pascagoula, Ala., for the erection of a machine shop and foundry.

The Dominion Steel Products, Ltd., Brantford, Ont., has started work on the erection of a new pattern shop.

The Art Foundry & Alloy Co., Cleveland, recently was incorporated with a capital stock of $10,000, by J. J. Schwab, S. Horwitz and others.

The Olney Foundry Co., Philadelphia, recently was incorporated with a capital of $600,000, by H. H. Cooke, S. B. Peck and Charles Pies.

The Atlas Foundry Co., Irvington, N. J., will erect an addition to its plant, 50 x 75 feet, to house its shipping and receiving departments.

The foundry and machine shops of J. S. L. Wharton, Philadelphia, have been sold to the H. S. & B. W. Cochran Corp.

The capital stock of the D. J. Ryan Foundry Co., Ecorse, Mich., recently was increased from $500,000 to $2,000,000.

The Morgan-Maass Products Co., Brooklyn, N. Y., welder, toolmaker and brass founder, recently was incorporated with a capital stock of $10,000, by S. G. Morgan, J. Wanser and H. C. Maass, 818 Fifty-ninth street, Brooklyn.

The Chatfield Machine & Foundry Co., Escanaba, Mich., has had plans prepared for doubling its plant, including the erection of a new foundry building.

The Weir Stove Co., Taunton, Mass., has awarded a contract for the erection of a foundry, 35 x 115 feet, a sand shed, one story, 48 x 60 feet, and a factory addition, three stories, 70 x 100 feet.

Capitalized at $5000, the Pittsburgh Gray Iron Foundry Co., Pittsburgh, recently was incorporated by George M. Hesack Jr., F. B. Wickersham and H. L. Allshouse.

The Bethlehem Foundry & Machine Corp., New York, recently was incorporated with a capital of $5000, by W. A. Wilbur, A. H. and R. H. Stevens, 149 Broadway, New York.

Architect H. Holder, 242 Franklin avenue, Brooklyn, N. Y., is preparing plans for the erection of a foundry, 100 x 250 feet. The name of the owner has been withheld.

The Westport Brass Foundry, Inc., Westport, Conn., recently was incorporated with a capital of $25,000, by W. A. Seide, C. D. Craig, Bridgeport, Conn., and H. R. Sherwood.

The Superior Pattern Co., Cincinnati, recently was incorporated with a capital of $10,000, by R. H. Schmees, R. Frankl, A. Frankl, W. Mentrup and others.

The Standard Brass Foundry, Portland, Oreg., recently was incorporated by Frank McCrillis, E. E. Small and others, and plans are being prepared for establishing a plant.

The Oldsmar Tractor Co., Oldsmar, Fla., is planning the erection of a plant, to include a foundry. The company recently increased its capital from $100,000 to $500,000.

The Beloit Iron Works, Beloit, Wis., has let the contract for the erection of an addition to its foundry, 117 x 160 feet, with 60 foot craneways for a 10 ton and a 15-ton crane.

The F. C. Blair & Son Co., Waukesha, Wis., gray iron founder, has purchased a plant site on which it is reported planning the erection of a new plant, work on which is to begin next fall.

The Michigan Foundry & Machine Co., Detroit, recently was incorporated with a capital of $40,000, by James R. Walsh, 476 Seyburn avenue, Detroit, and others.

Capitalized at $500,000, the Gartland-Haswell-Rentschler Foundry Co., Dayton, O., recently was incorporated by R. K. Landis, A. K. Meck and others.

The Charlotte Pipe & Foundry Co., Charlotte, N. C., plans the construction of a plant building, 100 x 100 feet. W. F. Dowd is president of the company.

Capitalized at $10,000, the Advance Bronze Aluminum Foundry Co., Cleveland, recently was incorporated by W. K. Gardner, L. M. Kelly, H. H. Gorman, M. L. Esch and I. Esch.

The Malleable Products Corp., Jamestown, N. Y., recently was incorporated with a capital of $500,000, to manufacture malleable iron, etc., by O. A. Leona and others.

The Hugh Park Foundry Co., Ltd., Oshawa, Ont., recently was incorporated with a capital of $200,000, by Frank A. Park, James Parket, 157 Bay street, Toronto, Ont., and others.

The plant at 60 Elm street, Newark, N. J., formerly occupied by the Acme Brass Foundry Co., has been sold to Lewis Weltz, Paterson, N. J., representing a brass foundry concern. The building is 50 x 110 feet.

H. H. Sack and M. I. Rappaport, 365 Myrtle avenue, Brooklyn, N. Y., recently were named as the incorporators of the Clifford Brass & Copper Co., New York, which was chartered with a capital stock of $50,000.

The Molders' Foundry Co., Inc., Chelmsford, Mass., has been incorporated to operate a foundry and machine shop with a capital of $50,000, by Charles C. Knight, John H. Davis, E. Berg, Edward Carolin, Peter J. Hanson and others.

The Benton Harbor Malleable Foundry Co., Benton Harbor, Mich., has purchased the plant of the Crary Machine Works, and the latter company has bought a site on which it will build a new plant, 72 x 200 feet.

The Sam W. Emerson Co., 1900 Euclid avenue, Cleveland, has been awarded the contract by the Superior Foundry Co., East Seventy-first street and Aetna road, Cleveland, to construct a new foundry building.

A recent increase in the capital stock of the West Steel Casting Co., Cleveland, was made to care for the surplus in the present valuation of the company. It has a 100-foot plant extension under construction.

The American Metal Products Co., 671 Kinnickinnic avenue, Milwaukee, has purchased a site in West Allis, and expects to start work soon on the erection of a new foundry, 80 x 220 feet, and a new machine shop, 75 x 150 feet. The company recently increased its capital from $100,000 to $300,000. George F. Staal is president.

For the purpose of making a proportionate distribution of stock to cover plant additions and improvements of the past 20 years, which were paid for out of the company's earnings, the Trenton Malleable Iron Co., Trenton, N. J., recently increased its capital from $150,000 to $500,000. No additions or improvements are contemplated at this time.

Controlling interest in the Malleable Iron Works, New Britain, Conn., manufacturer of castings, has been purchased by Auburn, N. Y., interests. M. C. Swift, who was president has retired, and Herbert Swift, who was secretary, will remain with the new owners. A reorganization has been effected with the following officers: President, George W. Bowen; secretary, Walter H. Beck; and treasurer, George W. Benham.

The Cuyahoga Foundry Co., Cleveland, which was recently organized with a capital of $200,000, to manufacture gray iron and semisteel castings, is planning to engage in active business shortly. The company has a plant, 109 x 180 feet, equipped with 10-ton and 3-ton traveling cranes. Officers of the company are: President, John Vild; vice president, Anton Anyz; treasurer, Charles Wachalee, and secretary, Frank J. Opatrny.

Contracts will be placed in about 60 days for the erection of a new foundry, 60 x 160 feet, for the Judy Mfg. Co., Centerville, Iowa. This will be equipped with modern appliances and the company now is in the market for cupolas, sand cutting machines, molding machines, sandblast equipment, electric traveling crane, and flasks. Gray iron castings weighing from one pound to one ton will be produced in the new plant. The building will be of steel sash, glass construction. C. A. Farrington is president; A. W. Judy, vice president; A. M. Peatman, secretary, and George M. Barnett, treasurer. The company manufactures roller bearing mine car wheels, universal joints, concrete mixers and pavers and 4-wheel drive trucks.

The Delaware Aluminum Co., Muncie, Ind., is erecting a foundry and machine shop.

The Holaday-Telford Co., Waterbury, Conn., manufacturer of patterns, etc., has increased its capital from $10,000 to $60,000, and now has one of the largest plants of its kind in the New England district. It recently installed some new equipment.

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Demand Induces Change in Output

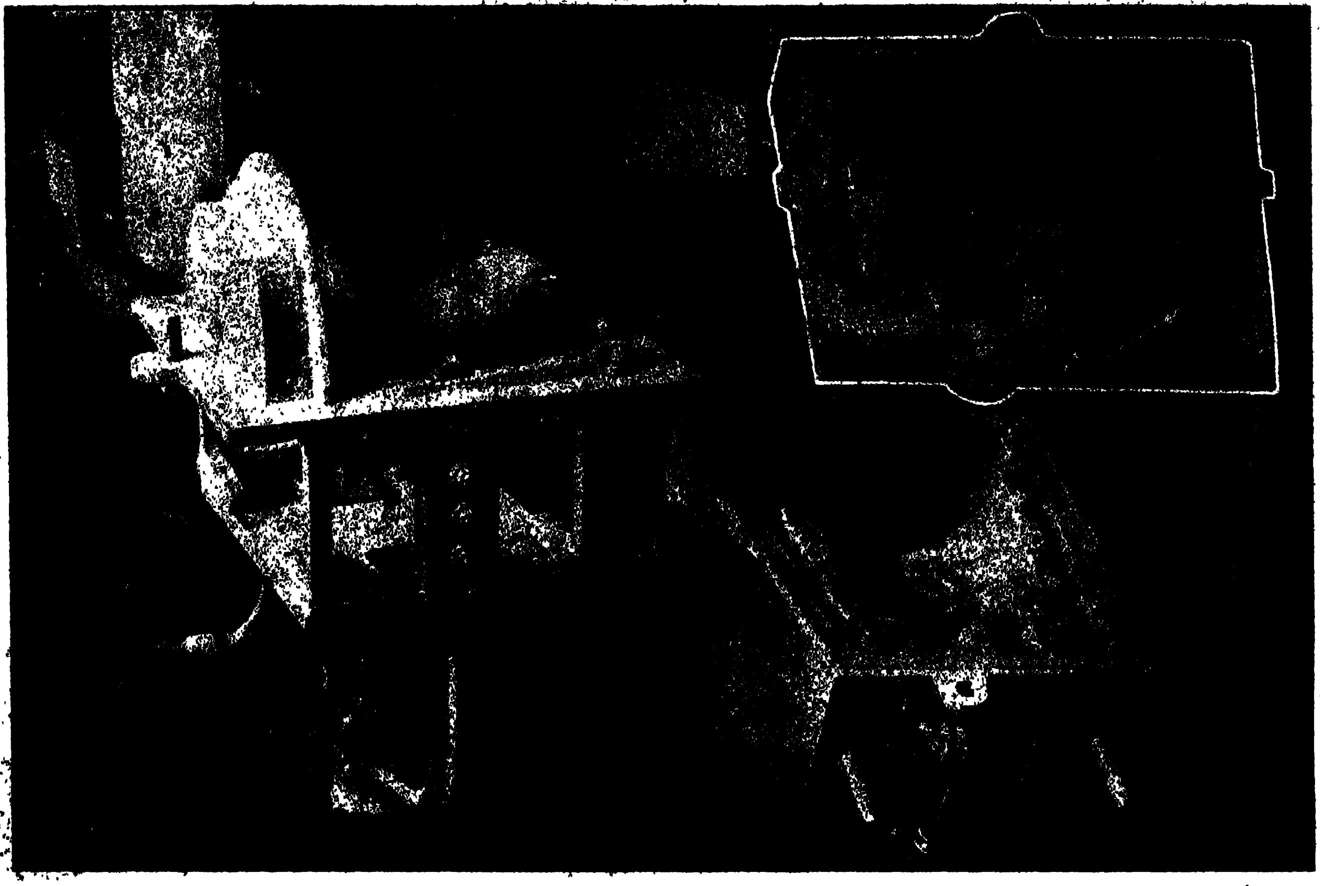
The Volume of Available Business in Recent Years Has Resulted in the Introduction of Special Equipment for the Production of Automobile and Gas Engine Castings on a Large Scale

CONSIDERING the number of foundries engaged exclusively or in part in the manufacture of castings for automobiles, one is led to wonder what some of them found to do before the automobile was invented. Many large plants have been erected and equipped during recent years expressly for producing engines, transmissions and differential housings, gears, sprockets and other parts for automobiles, trucks and tractors of various types. Still other foundries have been engaged either in whole or in part in turning out castings for molds, presses or other tools used in the formation or finishing of the rubber, the sheet steel and forged parts which enter so largely into the construction of self-propelled vehicles.

The foundries that were built to handle this class of castings are equipped with the most complete and accurate mechanical devices to insure that the cores and different parts of the mold are assembled in their proper relative positions. This is essential, due to the exceedingly thin section of some castings produced. As far as possible the personal equation is minimized by having almost everything done mechanically. Patterns are mounted on machines, rammed and stripped according to an arbitrary standard which lessens the chance of errors on the part of the operator. Cores are dried in formers, which prevent distortion, assembled by the aid of jigs and gages and held in place by chaplets and anchors which are located definitely instead of being placed according to the individual judgment of the molder who is closing the mold. Foundries which were built to handle a general line of work and afterward switched to the automobile field, found it necessary to adopt the ideas and methods prevalent in the shops which had been designed exclusively for the production of automobile castings.

The Bay View Foundry Co., of Sandusky, O., in the past has made large quantities of automobile castings, as well as 1 and 2-cylinder engines for electric

FIGS. 1 AND 2—MANIFOLD PATTERNS ARE SPLIT ALONG THE CENTER LINE—EACH HALF IS ATTACHED TO AN INDIVIDUAL PATTERN BOARD BUT THEY ARE BOTH RAMMED ON ONE MACHINE—NOTE THE STYLE OF GATE, ALSO THE CORE PRINTS OVER THE DRAG FLANGES



FIGS. 3 AND 4—THE COPE AND DRAG HALVES OF THE PATTERN ARE MOUNTED ON INDIVIDUAL STRIPPING PLATE STANDS—THE GATE WITH STRAINER CORE IN PLACE IS SHOWN AT *E* FIG. 4

light plants, power boats, electrical devices and other high class work requiring extreme care in the making.

A few jar-ram machines are employed in the Sandusky plant, but the most of the molds are rammed by hand, either on plain stripping plate machines or on rollover, pattern-draw machines. Snap flask molds are made on pneumatic squeezers. A certain amount of work, short orders, odd pieces, etc., still is made in this shop on the floor in the ordinary way, the molds being rammed by hand and the patterns drawn in the same way. Both wood and iron flasks are used at the present time but the tendency steadily is toward the substitution of iron and steel flasks when renewal is necessary.

Examples of wooden flasks may be seen in the illustrations, Figs. 5 and 6. These molds are made on hand-ram pattern-draw roll-over machines supplied by the Tabor Mfg. Co., Philadelphia. The manifold pattern shown in Figs. 1 and 2 is split longitudinally and each half mounted on a separate board. The board containing the drag half of the pattern is mounted on the machine first and the required number of drags rammed and set down in a double row on the floor. The drag pattern board is then removed and replaced by the board carrying the cope half of the pattern when a sufficient number of copes are rammed to cover the drags. The molds shown in Fig. 8 are made in a similar manner. The lift over the two pockets in Fig. 2 is facilitated by attaching core prints at the two points indicated by *A* and *B* in Fig. 2. This arrangement gives a flat parting for both cope and drag. After the drag has been placed on the floor and the main core set, the stop off cores are dropped into the pockets at each end, thus simplifying what would otherwise be an upward lift at these points.

A striking commentary on the question "what is a day's work?" is furnished by the job illustrated in Figs. 9 and 10. This is a small transmission housing weighing about 50 pounds, molded in a flask 20 x 20 inches, cope and drag each being 10 inches deep. The pattern is split in the center and each half is mounted on a mold board as shown. The drag board is placed on the machine first and a certain number of drags are rammed. It then is

FIG. 5—A FLOOR OF MANIFOLDS CORED READY FOR THE COPES—THE STOP OFF CORES K [illegible]NATE A DEEP LIFT AND MAKE A STRAIGHT PARTING POSSIBLE

FIG. 6—LONG STEM CHAPLETS ARE EMPLOYED FOR HOLDING DOWN THE JACKET CORES—THE UPPER END OF THE CHAPLET IS WEDGED UNDER THE BAR

taken off and the cope board is used until a sufficient number of copes have been rammed to cover the drags. A rollover pattern-draw machine is employed but the molds are rammed by hand and this is the principal feature on which opinions differ. When the mold is rammed with a nice sense of discrimination, as it is by some molders, the pattern will draw perfectly and no hand finishing is necessary. However, when the mold is rammed by men who have not this peculiar knack it will be more or less of a wreck and either will have to be shaken out or will require much patching. After painstaking efforts on the part of the management, this type of molding gradually has been perfected and has resulted in the development of a large number of first class operators.

As a precaution to prevent dirt from entering the mold, various types of skim gates are employed, depending upon the size and general characteristics of the casting. Strainer cores, similar to that shown at *E*, Fig. 4, are inserted at predetermined points in the runner to accomplish the desired purpose. Sometimes these are located in the pouring basin, occasionally at the bottom of the sprue, and again near the end of the gate just before it enters the mold. It may be noted that the runner on the manifold, Figs. 1 and 2, is modeled on the old fashioned *storge* gate; that is the runner is in the cope and the jets or branches are in the drag. This type gate is designed to catch and hold without the aid of a strainer core, any dirt which may enter the main runner.

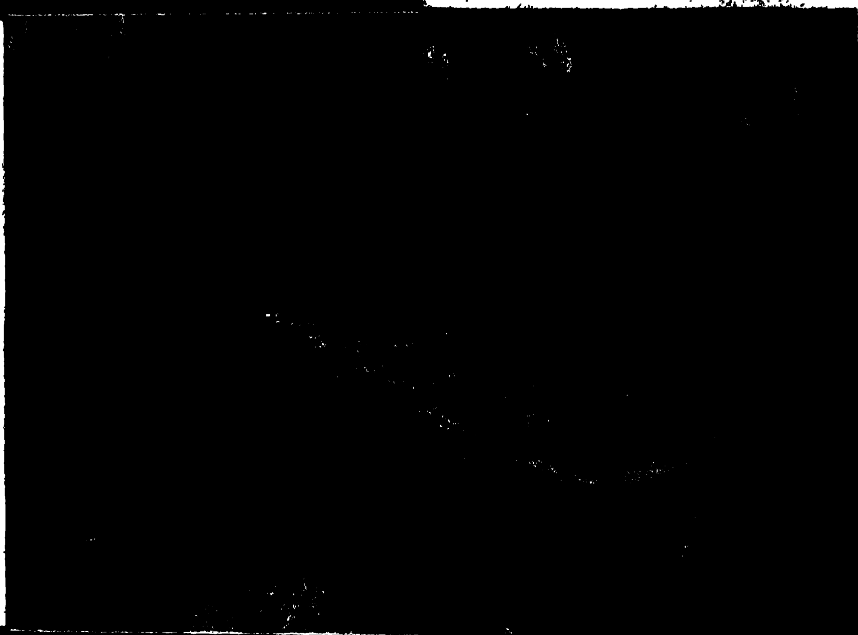
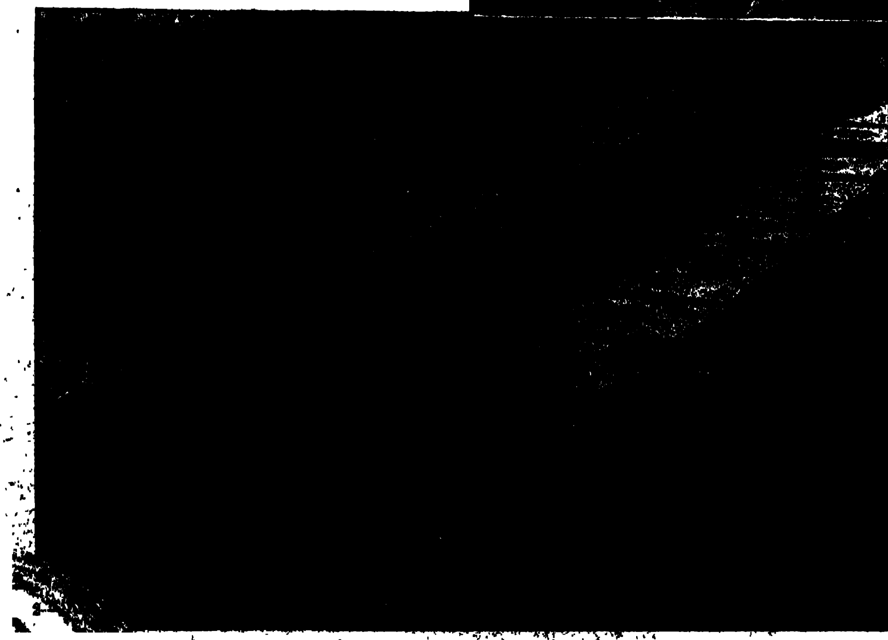


FIG. 8—WOODEN FLASKS STILL ARE USED TO A CERTAIN EXTENT IN MAKING THE CLASS OF CASTING SHOWN ABOVE

The pattern for the transmission housing shown in Figs. 3 and 4 is symmetrical and each half is mounted on a separate machine. The machines are plain stationary tables which act as stripping plates. The molds are rammed by hand after which the patterns are drawn pneumatically. Two men are employed on this particular pattern, one making copes and the other making drags. Part of a floor of molds is shown in Fig. 7. It may be seen from this illustration that the core also is made in halves and set in the mold one half at a time. After the cores are dried they are assembled on benches provided for that purpose, rubbed to a bearing and carefully calipered to the correct size. They then are taken to the molding floor and distributed, two



...IESE CORES ARE NOT PASTED AND WIRED TOGETHER BEFORE GOING IN THE MOLD—...E HALF IS SET IN THE DRAG AND THE OTHER HALF SET ON AFTERWARD

FIGS. 9 AND 10—THESE MOLDS ARE RAMMED BY HAND ON A ROLLOVER PATTERN-DRAW MACHINE—ONE MOLDER PUTS UP 60 MOLDS A DAY

halves to each flask. After the bottom half of the core is set, a little paste is laid on the joint close to the edge all around and then the other half of the core is set on. The top half is located in its correct relative position by observing that the boundry lines on the joint of each half coincide throughout their length.

One oven situated at one side of the main bay of the foundry at one end still is used for drying some of the cores. It is equipped with shelves along both sides, as well as with a car supporting several decks. It was once the only oven and sufficed to dry all the cores that were necessary, but now it only forms about 15 per cent of the core-drying capacity of the plant. A modern, up-to-date core room was erected and equipped some time ago to take care of the company's requirements in this respect. The latter covers a space approximately 75 x 100 feet, is constructed of brick and steel and is provided with ample lighting and ventilating facilities.

The end of the coreroom fronting on the railroad spur is provided with a number of concrete bins into which the sand is unloaded directly from the cars. Sandusky and Michigan City sharp sands, mixed in varying proportions, are used for making the cores. The sand is mixed in two revolving paddle type mixers made by the Blystone Mfg. Co., Cambridge Springs, Pa. Several mixtures are employed depending on the nature of the work in hand; but as a rule the sand requiring a liquid binder is mixed in one of the machines and that in which a dry binder is employed is mixed in the other. No attempt is made to salvage any of the old or burnt sand as the cores are made entirely of new sand. The floor of the core room is covered with a smooth coating of concrete and this renders it comparatively easy to keep it clean.

Many of the cores are small and are made by hand on the bench in the usual way. However, eight rollover, pattern-draw machines, made by the E. J. Woodison Co., Detroit, are employed, and for the deep cores, two roll-over, pattern-draw machines provided with a counter weight attachment are used. These were made by the International Molding Machine Co., Chicago. The cores having flat surfaces are dried on plates, but those of irregular or special shape are dried in formers composed of sand and oil. To make these formers a half core first is made and dried. This then is placed on a flat plate and surrounded by a shallow frame. This frame is rammed full of a strong oil sand mixture well reinforced by rods or wire. The frame containing the sand is covered by a plate and the whole assembly is rolled over. The half core is removed and also the frame after which the block of sand with the impression of the half core is placed in the oven and dried. A number of these driers always are kept on hand and it is stated that they may be used 40 or 50 times before their usefulness becomes impaired.

Four cars are provided for convey-

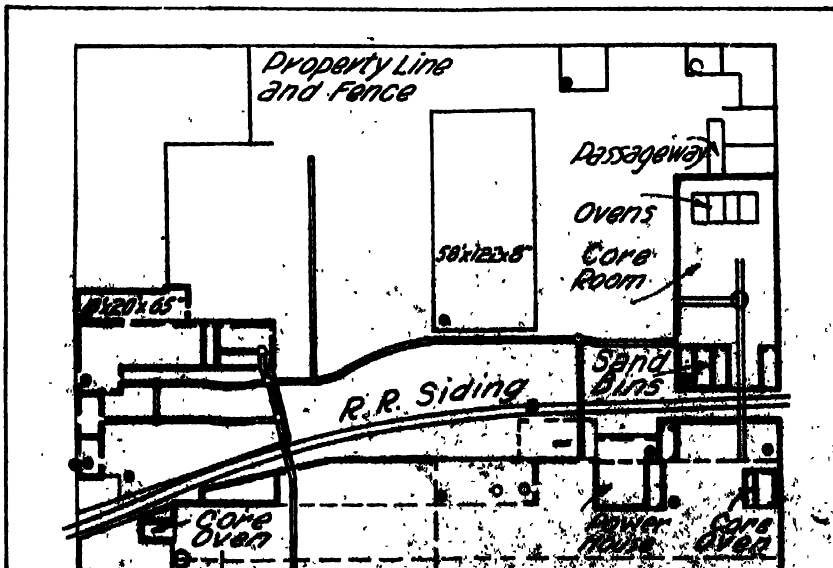


FIG. 11—GROUND PLAN SHOWING THE LOCATION AND RELATIVE POSITION OF THE UNITS COMPRISING THE PLANT

ing the cores into the ovens. As may be seen by referring to the illustration, Fig. 12, they are lightly but strongly built and each is provided with six decks. The longitudinal strips on the car are made of angle irons, a feature which insures a maximum contact of the heated air in the ovens with the bottom of the plates. The cores are dried in a battery of four ovens made by the Ohio Body & Blower Co., Cleveland. Each oven is 7 x 7 x 8 feet and is coke fired. Four drawer-type ovens fired by gas, made by the same company, also are employed.

Each of the large ovens is provided with a track to accommodate a car and also with a number of standards having graduated steps on which long pieces of pipe may be placed at any height to support the core plates. In this way the oven may be utilized for drying cores even if the car is not available or if the cores are too bulky to go on the car. Each oven is heated individually. The fire boxes are in a common pit at one end of the battery and the heated currents pass through a chamber under the floor entering the oven through a series of ports provided for that purpose. A large hood suspended over the door of each oven serves to carry off the fumes and heat when the door is opened.

FIG. 13—A TURNTABLE IN THE CENTER OF THE COREROOM FACILITATES THE HANDLING OF CORES AND OTHER MATERIALS

To facilitate moving carloads of cores from the core room to the foundry. a turn-table is provided at the junction of two branches of a narrow gage track. One branch track leads to the assembling room where the cores are tried by gage and templet. The other track extends across the yard and enters the foundry at a point nearly 300 feet distant.

A depressed track extends across the front of the four car ovens. A special underslung-body transfer car operates on this track and serves to change the cars from one oven to the other if necessary. The lock and catch shown at *L* and *M*, Fig. 12, are employed to bring the tracks on the car in line with any given set of tracks on the floor. With this outfit there is no waiting either for cars or for ovens. The cars may be shifted from one track to the other or from one oven to the other with the greatest facility.

A large floor upstairs over the assembling room has been equipped with classified and numbered racks and shelves to hold the immense stock of cores which always is maintained so that there will be no delay in production. A large, specially-designed, spring wheelbarrow is used for distributing a great number of the cores to the different floors in the foundry where they are needed.

FIG. 14—THIS UNDERSLUNG CAR OPERATES ON A DEPRESSED TRACK EXTENDING ACROSS THE FRONT OF THE FOUR OVENS

The foundry has a capacity of about 25 tons a day and metal is supplied by a cupola lined to 42 inches, made by the Northern Engineering Works, Detroit. The bed charge of coke is ignited by an oil torch introduced at an opening provided for that purpose at the back of the furnace and on a level with the sand bed. After the coke bed has burned through, the torch is removed and the opening bricked up. The iron and scrap charges weigh 1700 pounds each.

Several varieties of northern and southern irons are used, including about 10 per cent charcoal iron. The coke between the charges is not weighed but measured, eight forkfulls of coke yield satisfactory iron, hot enough to run any casting on the floor.

The blast for melting the iron is provided by a fan made by the Buffalo Forge Co., Buffalo. The blower is situated in an adjoining building which also houses the other power units, including two vertical gas engines, 140 and 50 horsepower respectively, made by the Lazier Gas Engine Co., Buffalo; two direct current generator sets, 110-120 volts, one supplied by the Westinghouse Electric Co., the other by the Allis-Chalmers Co., Milwaukee; and two belt-driven compressors, one made by the Ingersoll-Rand Co., and the other built by the Bury Mfg. Co., Erie, Pa.

The foundry building, 80 x 356 feet, is divided into three bays and contrary to the layout in many foundries it is practically all molding floor. The center bay is spanned by two electric traveling cranes made by the Northern Engineering Works, Detroit, one of 10 tons and the other 5 tons capacity. The foundry office is attached to one corner of the foundry building and has a door opening directly onto the molding floor.

A. W. Link, who retired as president on April 1 this year, together with two associates, organized the Bay View Foundry Co. in 1904 with $10,000 capital. The company first rented a building covering approximately 4000 square feet, but the business grew so rapidly that it was considered advisable to increase the capital and erect a suitable building. E. L. Marsh and four other men subscribed further capital in 1907, increasing the total to $40,000. Mr. Marsh was elected vice president and treasurer, a position he held until the retirement of Mr. Link, when he was elected president of the company. The capital has been increased twice since 1907, it now stands at $300,000.

From five to ten men were employed regularly during the first few months, this number had increased to 25 by the end of the year. At the end of 10 years there were practically 100 men in the employ of the company and at the present time there are approximately 225.

The first unit of the present plant was built in 1908. It covered approximately 12,000 square feet. Subsequent additions have brought it to its present size covering an area of about 70,000 square feet.

Some time ago the company installed a small converter and cupola and now is prepared to handle small and medium size steel castings in addition to gray iron and brass.

As necessary adjuncts to a complete plant, a well equipped pattern shop is maintained, capable of producing patterns of all descriptions either in wood or metal. A machine shop provided with all the necessary machinery for finishing small castings makes it possible for the company to perform every step in the process from the blue print to the assembled castings. The machine shop is relatively small compared to the foundry as most castings are shipped rough.

Handling Rush Work in English Shops

BY JAMES PEARSON

FOUNDRYMEN generally, at least those whose experience dates back 20 years or more are fairly familiar with the shop conditions touched upon by Pat Dwyer in a recent issue of THE FOUNDRY. He says, among other things, that the wind would not be put on until every mold was ready, until the last bolt was tightened and the last little ball of clay placed in the riser. That was fairly common practice at that time and for that matter is yet to a certain extent. However there are exceptions to the rule now and there were exceptions to the rule occasionally in those days. I remember at one time of putting on the wind to melt the iron for a job before the pattern came into the foundry. That statement may appear far fetched but it is the absolute truth.

I was foundry foreman at an engineering plant in England and at night played a violin in the theater orchestra where it was necessary that I take my place at 7:20 p. m. One day just as I had all the molds poured off and was about finished work for the day, the head of the firm rushed into the foundry and informed me that an engine crank had broken at a colliery and he wanted a new one cast as soon as possible. I instructed the cupola man to let the cupola stand until I came back and then went to look at the pattern. I found it to be for a casting which would weigh about 1500 pounds. I instructed the cupola tender to charge the necessary amount of iron and put on the wind at once. About 5 minutes after the wind was on, or at 5:15 p. m. the pattern was brought into the foundry and at 6:30 the metal was in the ladle ready for the job which we were at that time engaged in blacking.

The crank was poured at 6:45 and having left two men to feed it, I rushed home, consuming about 20 minutes in the journey, and 15 minutes later was in my place in the orchestra.

The work in the foundry consisted of hauling, pumping and winding engines principally for colliery work, but we also made propellers for canal boats. The rig for making these wheels comprised a round iron ball, three individual blades, a spindle, seat and a templet. The ball or hub was provided with three holes equally spaced to locate the pins on the ends of the blades.

In making a propeller with this rig, the spindle seat and spindle first were set up. Then a collar was slipped over the spindle and located at a definite point on the spindle with a set screw. The hub was then dropped down until it rested on the collar after which one of the blades was set in position by inserting the pin on the end of the blade into the hole in the hub provided for that purpose. A templet, attached to an arm swinging on the spindle and conforming closely to the contour of the cope side of the blade, was used to hold the blade to the proper angle, or pitch, while ramming the under side. Each of the three blades was treated in a similar manner and when the third parting was made, a cope large enough to cover the complete mold was lowered into place and rammed full of sand.

We made quite a number of these castings and the rig was considered satisfactory until an incident arose which caused me to change my mind and which resulted in getting two castings a day where we formerly only could get one. The rig for making these small 3-foot diameter propellers was in use some time before I was engaged as foundry foreman and one casting per day was considered a days work for a molder. A man could easily finish the mold an hour before quitting time and shortly after I had taken charge I had occasion to ask the man after he had closed the wheel to make two small open sand plates for a pipe core. He refused on the ground that the propeller was a days work. I told him I intended to get two a day in future. The next casting that was made I had finished up in good style for a pattern and afterward had no trouble in getting two castings a day.

Increases Capital Stock

The capital stock of the Werner G. Smith Co., Cleveland, makers of core binders, has been increased to $750,000 to provide for new buildings and improved manufacturing appliances. The increase is made in common stock, from $100,000 to $700,000, while the preferred

Will Make New Line

The Worthington Pump and Machinery Corp., 115 Broadway, New York City, which has manufactured hydraulic machinery since 1840, recently has completed preparations to produce water power machinery including turbines and auxiliary equipment.

The R. Herschel Mfg. Co., Peoria, Ill., has awarded a contract for the construction of a new gray iron malleable foundry, 127 x 284 ... C. Peterson is foundry man...

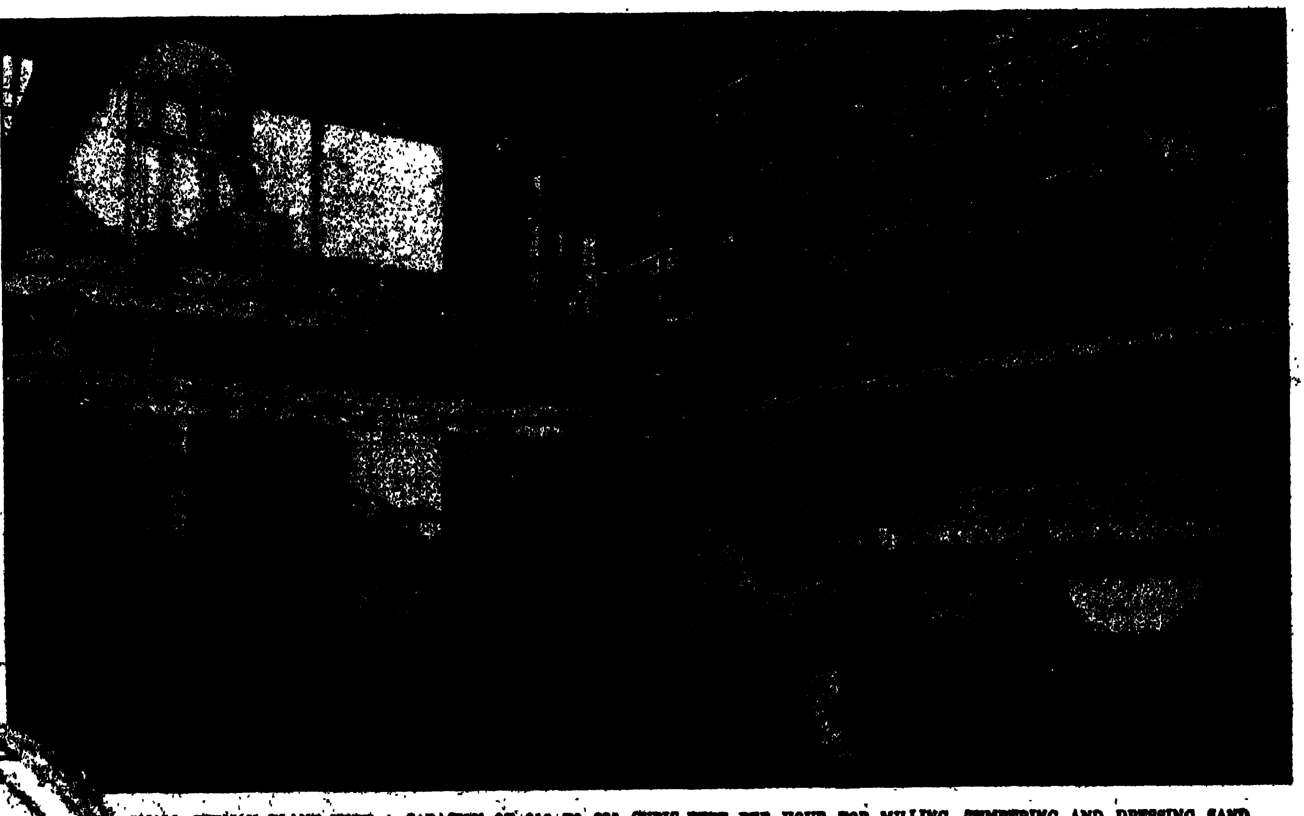
German Foundries Must Conserve

Shortage of Raw Materials, High Prices and Labor Inefficiency Have Combined to Force Adoption of Mechanical Methods—An Inside View of Technical Conditions in German Foundries at Present

BY HUBERT HERMANNS

WE CAN learn even from those who recently were our enemies—in fact it can be said we should learn specially from our enemies. Therefore THE FOUNDRY *feels every assurance in presenting this article which gives an accurate inside view of recent technical progress in the German castings industry. Written strictly from the technical standpoint for the purpose of conveying information regarding practice and methods, this article contains facts with which every foundryman should be acquainted. Special attention is called to the interesting details presented covering cupola-charging apparatus of the skip-hoist type, automatic overhead trolley systems, and slag reclamation plants.* THE FOUNDRY *offers this article as the only authoritative review of German foundry practice from the technical standpoint which has been printed west of the Rhine for over six years. Our readers thus are given unique service which only* THE FOUNDRY *is able to render through its specially organized European division, which procured, translated, and edited this article. The author, Hubert Hermanns, is a prominent German foundry engineer residing in Berlin.*

WHEN the war broke out the foundries in Germany found themselves confronted by problems to cope with which they were not properly organized. Large increases in production were necessary in certain directions, particularly in the steel casting field, and it is well known that before the war the majority of German foundries were not prepared for quantity production in the same manner or to the same extent as many of the casting plants in the United States. A large number of the foundries in Germany, in fact, are small establishments which cannot readily be arranged for quantity production. Soon after the war started, the German foundries found themselves hampered in unexpected directions. For instance, certain raw materials, such as English pig iron, to the use of which their practice had been adapted, suddenly became unobtainable and German materials had to be substituted. Among the steel foundries the scarcity of manganese soon became acute. In all sections of the German foundry industry the coke showed an increasing percentage of sulphur and ash as the war went on. Furthermore, during the latter years of the conflict, pig iron became so scarce that the melters were compelled to use large quantities of scrap of indifferent quality. This, together with the fact that the only pig iron which could be obtained was low in silicon, the usual range being 1 to 1.50 per cent, multiplied the difficulties which had to be confronted. This combination of causes brought about a continual increase in the percentage of sulphur in the castings and in 1918 the castings usually contained from 0.15 to 0.20 per cent sulphur. On account of the low silicon in the pig iron the castings



SMALL GERMAN PLANT WITH A CAPACITY OF 210 TO 280 CUBIC FEET PER HOUR FOR MILLING, TEMPERING AND DRESSING SAND

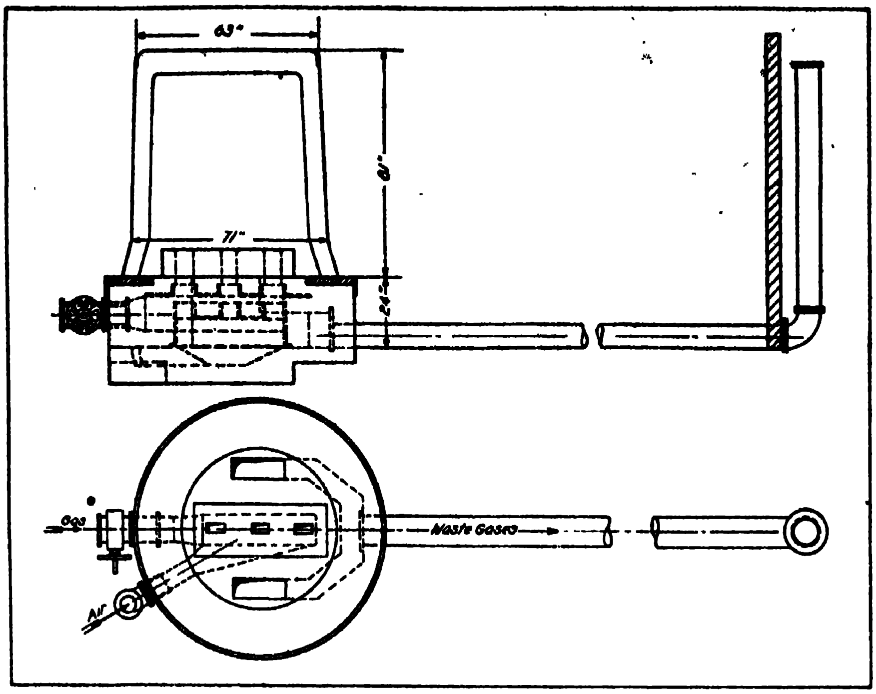
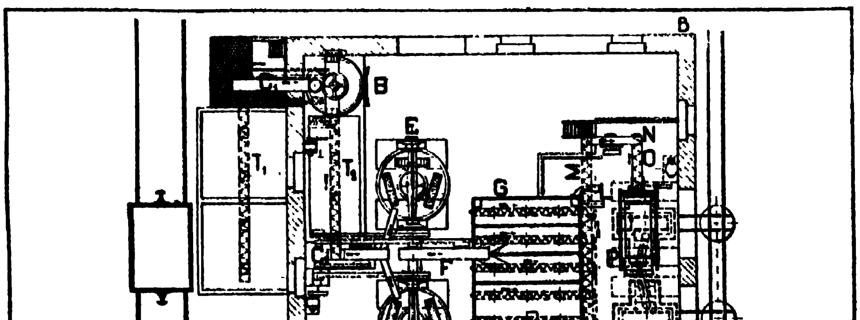


FIG. 2—GAS-FIRED LADLE DRYER

frequently were extremely hard. They also exhibited a tendency to alter their shape and to develop internal strains. The proportion of silicon in the scrap also decreased continually during the war. The only remedy for these difficulties was to use as much high-silicon pig iron—silvery iron—as could be obtained. In short, the German foundries had to make the best of a bad job during the war. These unfavorable conditions still persist to a large degree. Those shops which were provided with their own laboratories did not suffer from these difficulties as much as the great majority of smaller plants in which rule-of-thumb methods were followed.

Although the metallurgical difficulties were only partly overcome, considerable progress was made in other directions through the introduction of labor-saving equipment. The war turned out to be a great stimulus to the installation of labor-saving machinery in German foundries. Nearly all of the able bodied men were called to the colors by the military authorities and therefore it was imperative to replace their efforts and at the same time to increase production to meet war demands. The labor shortage was partly relieved by the employment of women to a degree which had hitherto been considered impossible in foundries. This, in turn, however, necessitated the simplification of the work in such a way as to enable women to satisfy the requirements. As a result, the use of molding machines was very largely increased.

Still it has to be admitted that important improvements in German molding-machine design and methods of operation were not realized during the war. On account of the tremendous demand for output, machines and methods which had been tried before and were therefore dependable, had to be employed. As a matter of fact, there was not time available for carrying out experiments. Nevertheless the experiences which German foundrymen passed through from 1914



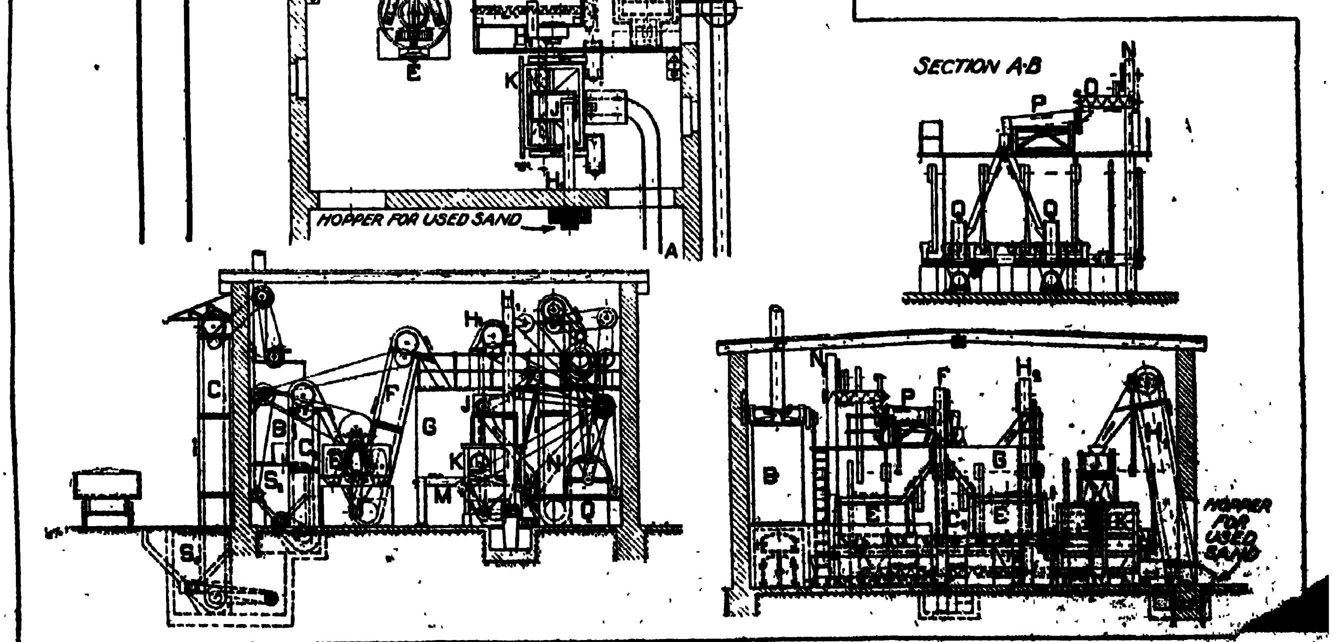


FIG. 3—PLAN AND SECTIONAL ELEVATIONS OF MOLDING-SAND AND TEMPERING DRESSING PLANT WITH A CAPACITY OF 210 [illegible] CUBIC FEET PER HOUR

to 1919 taught them a great deal about the effective use of molding machines and there can be no doubt that German foundry work will benefit by this experience in the future.

Like other belligerents, Germany was compelled to make a special effort to increase the production of steel castings and it was the electric furnace process that benefited most from this development. Electric-furnace design has shown considerable improvement in Germany since the war. Two types of arc furnaces, the direct and the indirect, as well as induction furnaces, now have been thoroughly tested. These types probably will remain in service under peace conditions. The output of steel castings in Germany in 1913 was 357,109 tons. This was increased to 1,471,042 tons in 1917, according to figures presented with the general article on German foundry conditions published in the April 15 issue of THE FOUNDRY. Figures on the production of electric steel castings in Germany show that they increased 19,536 tons in 1908 to 219,700 tons in 1917. Before the war there were about 20 establishments in Germany using electric furnaces; during the war the number of establishments employing this method of melting was doubled. The electric furnaces built in Germany during the war have an average capacity of 6.07 metric tons each.

Three of the main objects of German foundrymen throughout the war and also during the past 1½ years have been to develop more efficient methods of burning coke, to save fuel by the conservation of heat, and to utilize waste products. In the opinion of the author some noteworthy advances have been achieved along this line.

Many Oil-Fired Furnaces

Most of the steel foundries in Germany using open-hearth furnaces can be kept going at present only during the day time. This was also true during the war and, therefore, the use of oil-fired open-hearth furnaces has greatly increased. Tar oil, which is obtained from coking plants, is the fuel usually employed. This change to oil fuel has been stimulated by the shortage of coal and the necessity for utilizing all possible sources of heat. In the German oil-fired open-hearth furnaces burning tar oil, the average time from the beginning of the heat to the moment of tapping is three hours. These oil-fired furnaces are said to produce an unusually good quality of steel. The fuel cost is about the same as with furnaces fired with producer gas but there is a saving in wages and in capital [illegible] and the total cost per ton is [illegible] usually less with the tar oil-

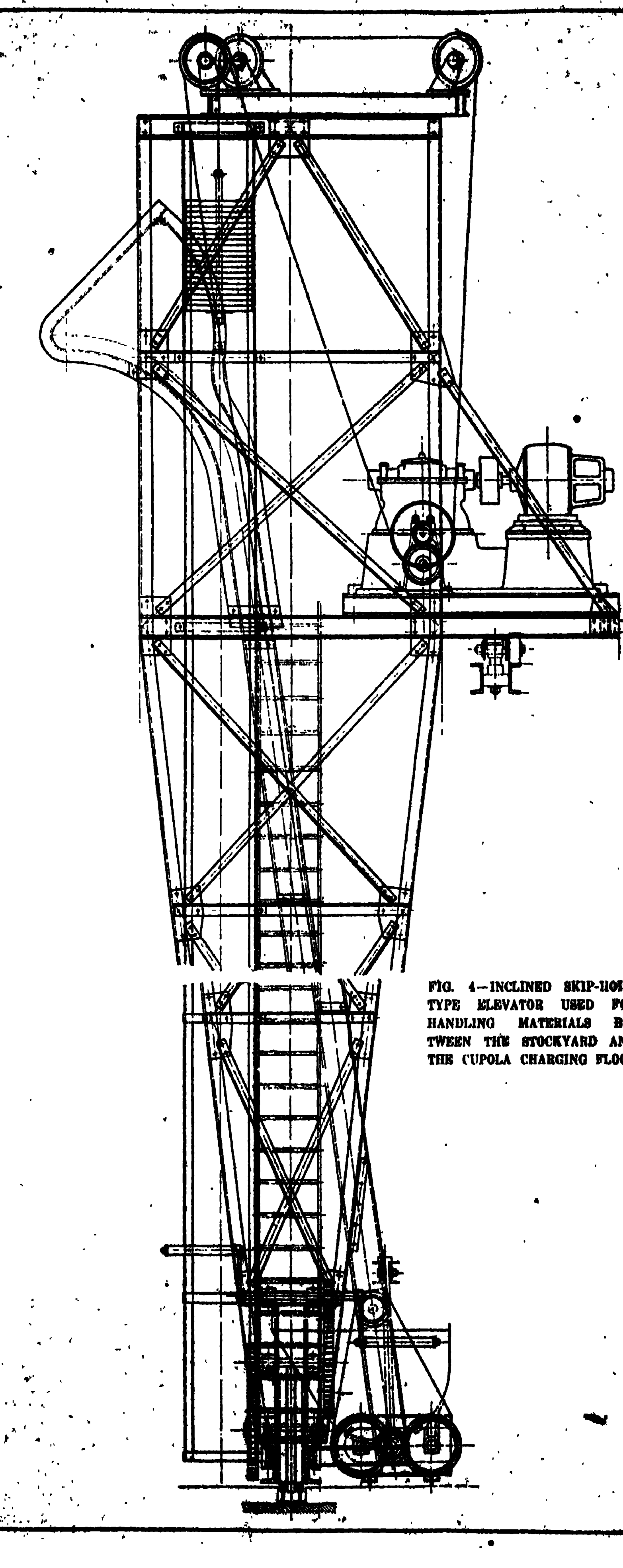


FIG. 4—INCLINED SKIP-HOIST TYPE ELEVATOR USED FOR HANDLING MATERIALS BETWEEN THE STOCKYARD AND THE CUPOLA CHARGING FLOOR

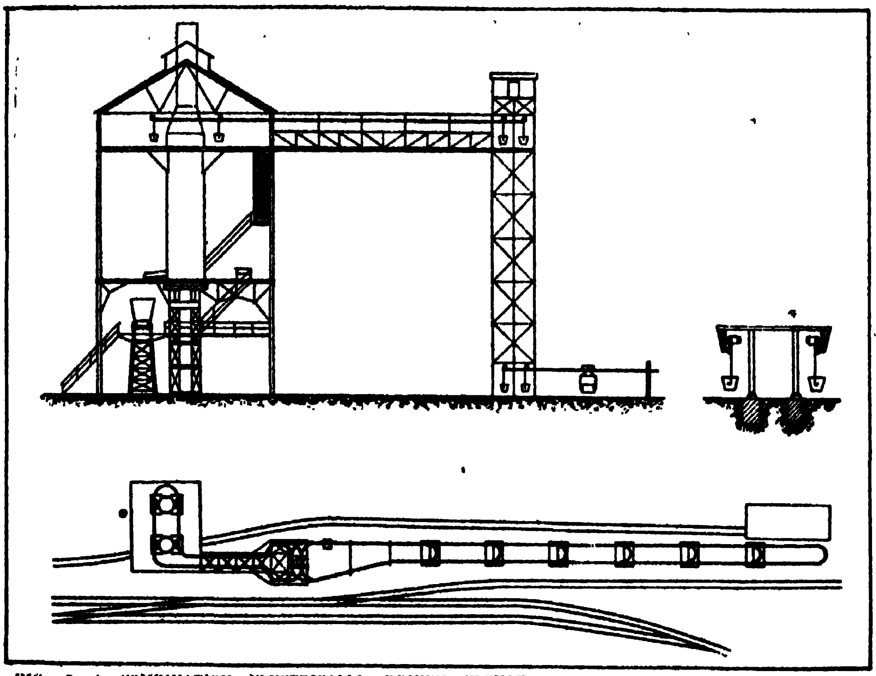


FIG. 5—A COMBINATION ELECTRICALLY DRIVEN ELEVATOR AND AUTOMATIC TELPER SYSTEM FOR HANDLING THE CUPOLA CHARGES

fired furnaces than with gas fired units.

In the converter foundries, a large number of multistage motor-driven turbo-blowers have been installed. Fig. 10 shows a modern turbo-blower of German design and construction built for this purpose. This size of blower contains eight rotors connected in series, the casting being split horizontally in the usual manner. It is unnecessary to provide facilities for cooling the blower, owing to the low pressure at which it operates. These blowers, it has been ascertained by tests, develop their highest efficiency at 2175 revolutions per minute. At this speed the efficiency is said to be 80 per cent. It is also said that the efficiency is not seriously affected by wide changes in load and that the blowers are flexible as regards volume of air delivered.

Use of Briquetted Borings

Briquetted borings are now being extensively employed in German foundries as a substitute for pig iron and ordinary scrap. Some progress had been made in the use of this material before the war. As a result of wartime experience both in the manufacture and melting of the briquettes it is stated that the castings turned out are usually equal in quality to those made entirely from expensive pig iron and high grade scrap mixtures. In the earlier days, difficulties were encountered in machining castings made from mixtures containing compressed borings, but this trouble has now largely been overcome, in the opinion of the author. The use of briquetted borings has also been found to provide a suitable means for preventing sponginess in castings at points where abrupt changes in section militate against proper solidification. The briquettes, however, must be used properly in the cupola and the peculiarities of briquetted iron have to be taken into consideration. If too large a proportion of briquettes is employed, the castings will be too hard owing to the excessive reduction of graphite and silicon. The following table gives mixtures containing borings which have proved satisfactory both for machinery castings and ordinary castings:

	Machinery Castings Per Cent	Ordinary Castings Per Cent
Hematite pig iron	10	15
German No. 3 foundry pig iron	20	..
Luxembourg No. 3 foundry pig iron	..	35
Special pig iron low in carbon	15	..
Cast scrap	30	45
Briquetted iron borings	15	5
Briquetted steel turnings	10	..

Machinery castings made from the foregoing mixture should contain 1.03 per cent silicon; 0.4 per cent phosphorus; 0.8 per cent manganese; and 0.08 per cent sulphur, and show a tensile strength of 35,400 to 39,800 pounds per square inch. The ordinary castings made from the foregoing mixture should contain 2 per cent silicon; 1.2 per cent phosphorus; 0.5 per cent manganese; and 0.13 per cent sulphur, and have a ten-

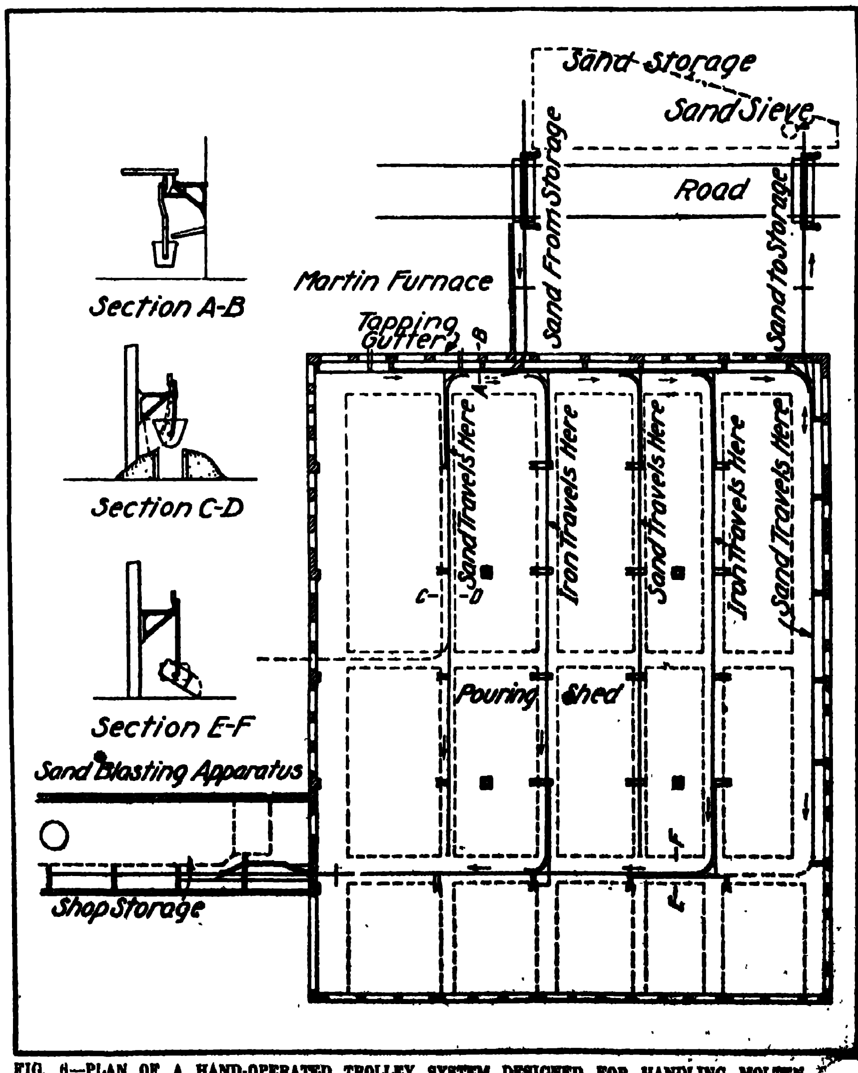


FIG. 6—PLAN OF A HAND-OPERATED TROLLEY SYSTEM DESIGNED FOR HANDLING MOLTEN IRON, CASTINGS, AND SAND

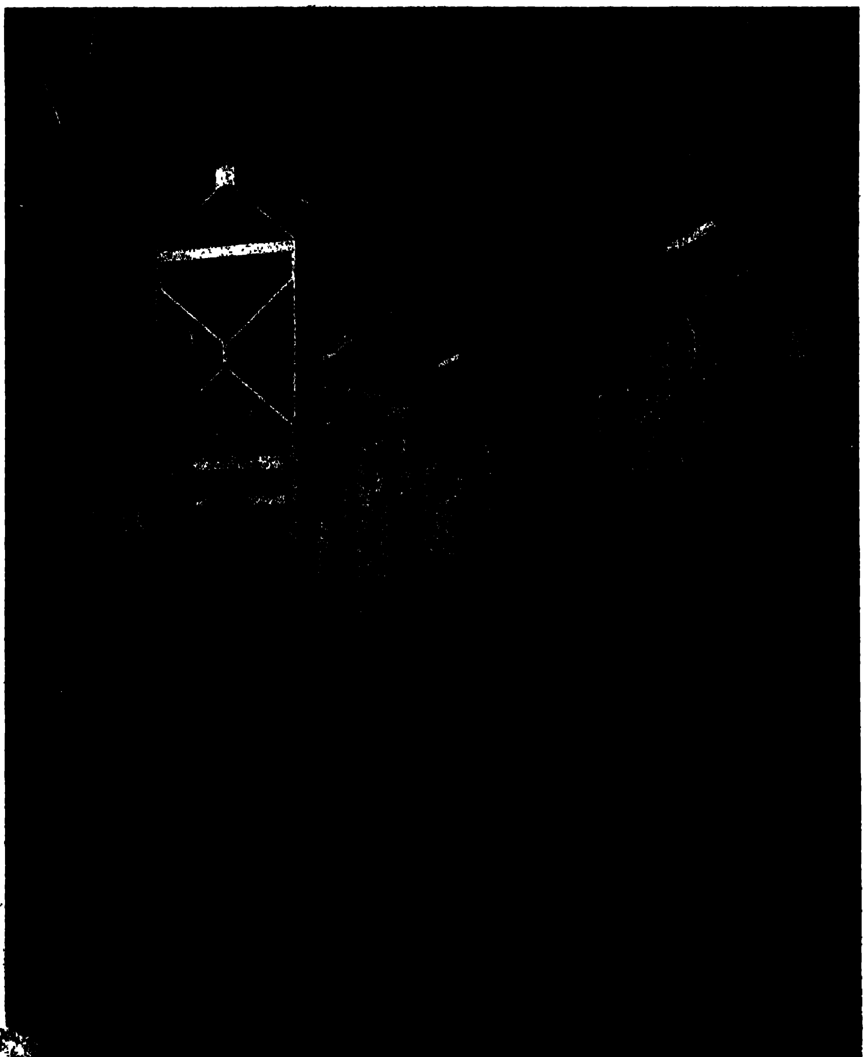
sile strength of 19,750 pounds to 24,100 pounds per square inch.

In many foundries wasteful methods of drying and heating the pouring ladles are employed. An arrangement devised in Germany during the war to save heat used in this operation is illustrated in Fig. 2. In the device illustrated in Fig. 2, the gas and air is conveyed to the mixing chamber in separate pipes. A triple Bunsen burner is employed. The waste gases of combustion are drawn off through two openings and in some plants are utilized for heating core ovens.

Elaborate Sand-Handling Plants

Considerable progress has also been made in Germany recently in the development of sand-handling and dressing apparatus. The design and arrangement of a mechanical sand-handling plant depends mainly on local conditions such as the size of the available space, the nature of the sand used, and the kind of castings to be turned out. In many cases even in many large foundries a few suitable self-contained devices are all that are required. However, when conditions call for a mechanical sand-handling plant, recent experience indicates that the apparatus should be designed to combine a large output of sand with minimum floor space, low first cost, and moderate repair and operating charges. Fig. 3 shows a general arrangement of a recently constructed large German plant for preparing and tempering foundry sand. The raw sand is brought into the foundry on railroad cars from which it is dumped into the floor bins S_1. A screw conveyor T_1, which extends under these bins delivers the sand to the boot of the vertical elevator C_1, from which it is in turn discharged into the vertical drying oven B. The dryer delivers the sand to the screw conveyor T_2, which is connected to the vertical elevator C_2. The latter discharges the sand into the two mullers E. After passing through these devices the sand is again raised by the elevator F and discharged into the mixing tank G. At this point the used sand is introduced. It arrives by means of the elevator H_1 which delivers it first to the magnetic separator J and thence to the revolving screen K. From the screen, the sifted sand is picked up by the elevator H_2 and discharged into the mixing tank. The latter is divided into several sections under each of which a screw conveyor is installed. These conveyors in turn deliver the mixed sand to the large screw conveyor M from which a connection is effected by means of the elevator N and the feed screw O with the cylindrical moistening and mixing drum P. The latter discharges the wetted sand into the two centrifugal disintegrators Q. After leaving the disintegrators the sand is fully prepared and ready for distribution throughout the foundry. Small cars operating on

FIG. 8—A CHEAP TROLLEY SYSTEM OPERATED BY HAND



...—TROLLEY SYSTEM WITH SPECIALLY DESIGNED, SELF-WEIGHING CHARGING BUCKETS INSTALLED IN AN OPEN-HEARTH STEEL FOUNDRY

the industrial tracks shown on Fig. 3 are utilized for distributing the prepared sand. A simplified plant of similar general design is shown in Fig. 1. In this case the prepared sand is dumped from the bins shown at the right, buckets running on an overhead track by which it is distributed to the molding floors.

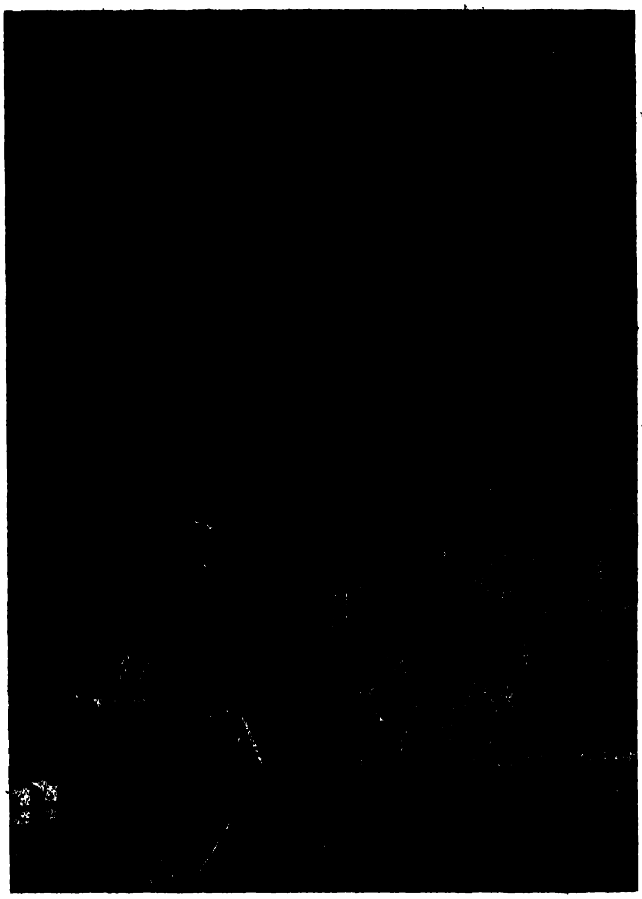


FIG. 9—A MAN-OPERATED OVERHEAD TROLLEY INSTALLED IN A LARGE GERMAN FOUNDRY

FIG. 10—ELECTRICALLY DRIVEN MULTI-STAGE BLOWER

German foundrymen have always paid considerable attention to cupola charging apparatus and during the war improvements were introduced in this field. In the last five years there has been a great increase in the use of inclined elevators in place of the ordinary vertically arranged elevators usually employed for hoisting the pig iron, scrap, coke, etc., up to the charging floor. These inclined elevators are peculiar to German foundries. They operate on the blast-furnace skip-hoist principle except that removable buckets are used to carry the charges. A system of narrow-gage tracks is utilized to handle the buckets from the places where they are filled, in the stockyard, to the foot of the elevator. The elevator carriage in which the bucket rests while being hoisted runs between guide rails. The upper ends of these rails are bent toward the cupola, thus forcing the bucket to assume an inclined position and to empty its contents into the chute connected with the charging door. The hoist mechanism consists of a motor mounted on a platform at the upper end of the elevator. This motor drives two symmetrically arranged rope drums through a spur wheel and worm gear. The weight of the bucket and charge is equalized by a counterweight. The general arrangement of an inclined hoist of this character, which has a capacity of 2350 pounds, is shown in Fig. 4. It is controlled from the ground by ropes. It is also possible in case of emergency to move the carriage by hand cranks operating through spur gears. In many cases electrically-driven elevators operated in combination with telphers or trolley systems have been adopted. In plants of this description the telpher cars are loaded either directly from the railway cars or from storage piles or bins. Then the telpher trolleys, which are automatically driven by small individual motors, proceed with their loaded buckets to the elevator by which they are hauled up to the charging floor and then shifted to another trolley system provided at this level. The telpher cars, from which the buckets containing the charges are suspended, move automatically to the furnaces where their contents are dumped without manual labor. A typical layout is illustrated in Fig. 5. In this case the overhead trolley tracks cover the whole stockyard, but the installation of switches at suitable points makes it unnecessary for the telphers to travel the entire distance. The cars are weighed automatically with their loads. After leaving the scales they proceed to the elevator, which is a double one in this instance. This elevator operates at a speed of 3¼ feet per second.

In modern practice in Germany, as in other countries, the molten iron usually is transferred from the cupolas to the molding floors by traveling cranes, overhead trolleys, or small trucks. Cranes usually are used in the large establishments, and the trolleys and trucks in smaller foundries. Hand-operated overhead trolleys are extensively employed in German foundries producing large quantities of small castings. The general arrangement of a plant of this character is shown in Fig. 6. In this case, of course, the overhead system is used for handling liquid iron, castings, sand and other materials. The sand-storage bins are located across the road from the plant proper. This has necessitated arranging a section of the trolley track over the road so that it can be lifted up when the system is not in use, in order to avoid impeding the traffic on the highway.

The automatic telpher system found in so many German plants, it should perhaps be explained, is somewhat different than the usual overhead trolley apparatus employed in American and British shops. The feature of the German overhead system is that the trolleys operate automatically. Each trolley is fitted with a small electric motor, and once it is set in motion it proceeds along the overhead track with its load at a predetermined uniform speed at about 3 feet per second and it may be stopped or started without human attention at any predetermined points by automatic contact switches. This method of handling materials is quite extensively used throughout the German iron and steel industry, and in some cases automatic telpher lines 2 or 3 miles in length are in use.

Fig. 7 shows how the open-hearth furnaces in a German steel foundry are charged by a recently constructed hand-operated trolley system. The buckets have inclined bottoms to permit the charge to drop out of

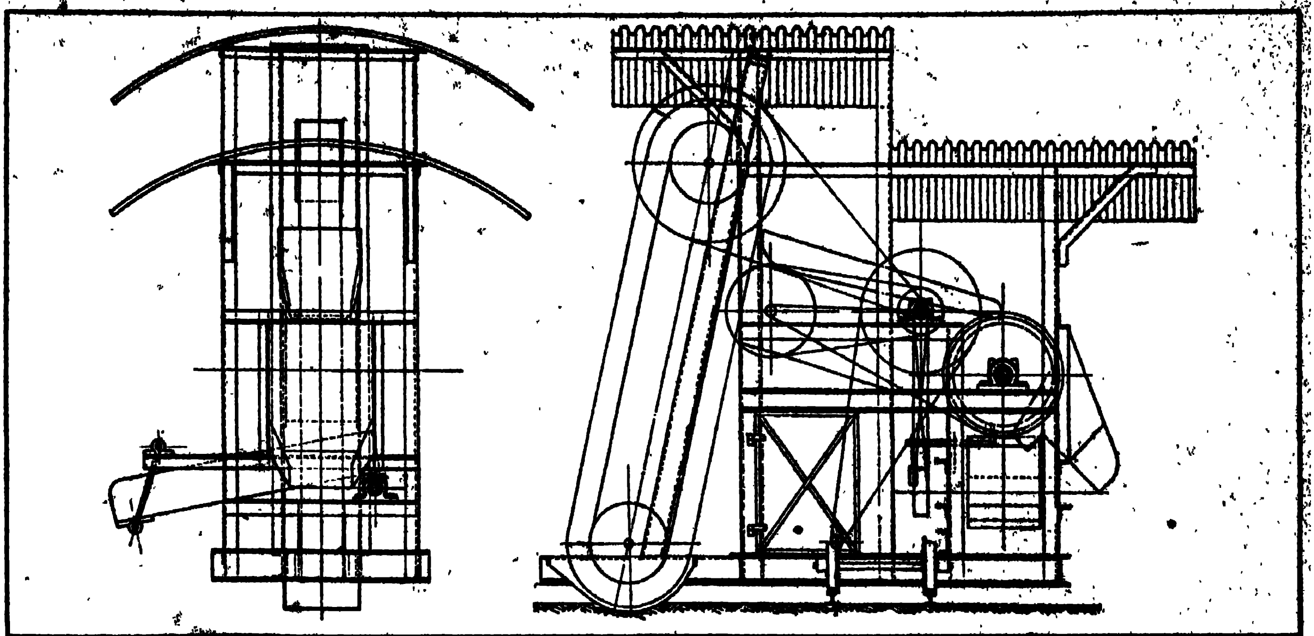


FIG. 11—A SMALL PORTABLE PLANT FOR RECOVERING IRON FROM FOUNDRY WASTES BY MAGNETIC SEPARATION

Each bucket carrier, it also will be noted, is provided with its own scale and weighing mechanism. Another recently constructed German overhead trolley system is shown in Fig. 8. In this case a distributing ladle of the familiar European cylindrical type is illustrated. Some characteristic German molding machines are also shown in the background. The overhead system shown in Fig. 8 may be constructed cheaply. A large number of installations of this character were made during the war. A self-contained trolley provided with an operator is shown in Fig. 9. Installations of this character have been introduced within the past few years for handling molten iron and other materials only in foundries of the largest size. Fig. 9 also shows a typical modern German cupola. It will be noted that the wind box is at a considerable height above the hearth and that an auxiliary tuyere is provided at the hearth level, together with a double row of tuyeres opening out of the wind box.

Waste Products Must Be Utilized

The scarcity of raw materials has resulted in the extensive development of apparatus for the reclamation of foundry wastes. The principal waste products to be dealt with include slag and rubbish. Before the war it was not customary in Germany to work over the slag obtained from the cupola furnaces but a majority of the plants have now been equipped with apparatus for recovering the iron which is lost in this way. It has been found that cupola slag contains frequently from 10 to 12 per cent iron. A cross section of a foundry-slag reclamation plant is shown in Fig. 12. This is a typical German plant operating on the mechanical principle.

When this plant is in use, the slag from the cupola is shoveled onto a floor grid through which the smaller pieces fall at once to a belt conveyor. The large lumps are crushed on the grid by hand until they fall through.

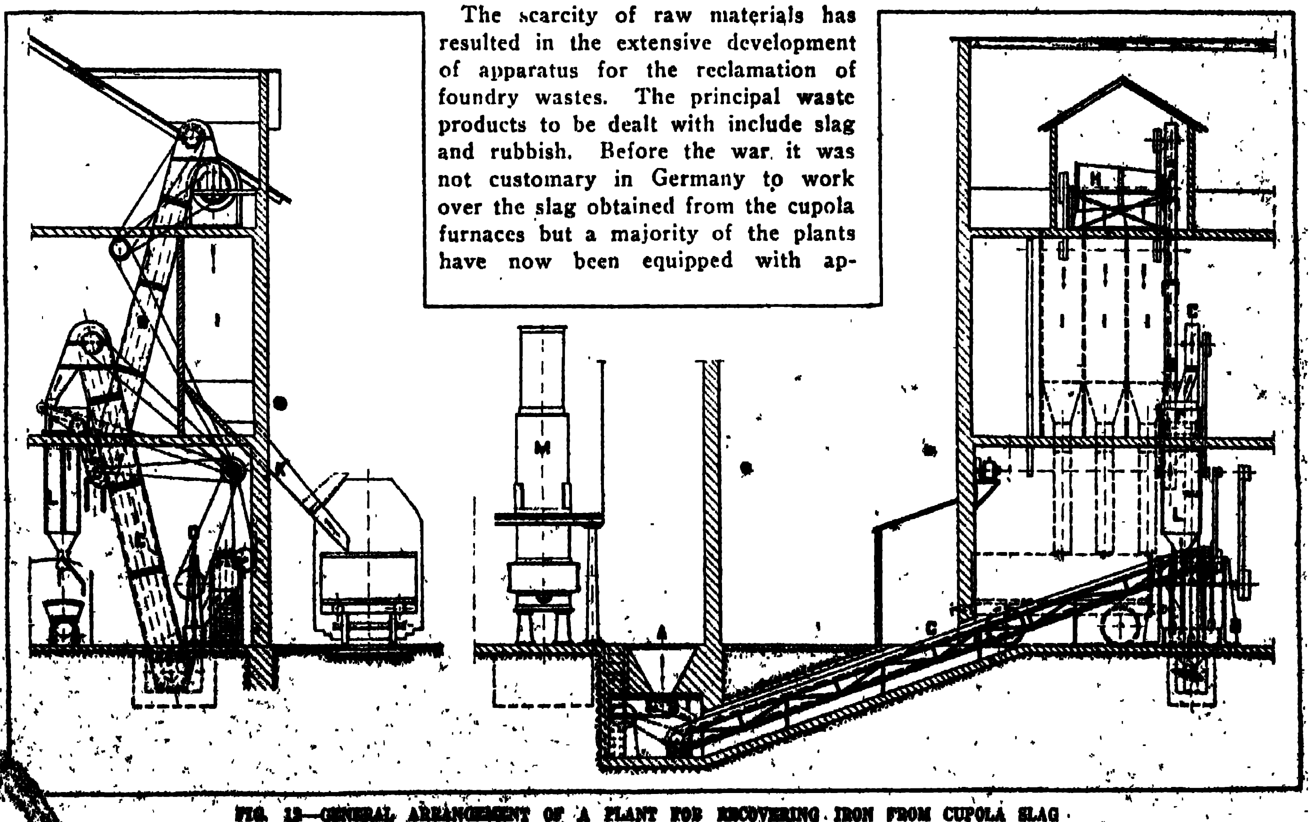


FIG. 12—GENERAL ARRANGEMENT OF A PLANT FOR RECOVERING IRON FROM CUPOLA SLAG

The belt conveyor delivers the slag to an ordinary stamp mill of the type used in western American mining camps. After it is crushed by the stamps, a bucket elevator conveys the slag to a magnetic separator. The iron is removed at this point and deposited in a bin. The iron-free slag is then elevated to a cylindrical screen by which it is sorted out into three different sizes.

The plant shown in Fig. 12 is designed exclusively for the recovery of iron from the slag, but many German foundries are now working over all of their waste products. It has been found that the waste gangway sand, etc., which is usually thrown on the dump contains appreciable quantities of iron, amounting usually to about 2 per cent, and in some cases as much as 3 per cent of the total quantity of castings made. The cost of working over these waste products is small in comparison with the extremely high prices which have to be paid for pig iron and scrap at the present time. Magnetic separation is employed almost exclusively. The costs are confined to the wages of one or two men, the cost of power and the capital charges. Experience shows that under present German conditions even the smallest foundries are able to effect considerable savings by recovering the iron from their slag, gangway sweepings, cupola drop, etc.

A portable apparatus for recovering iron from foundry wastes is shown in Fig. 11. It consists of a carriage, an elevator and a magnetic separator. The material is deposited on the magnetic drum by a shaker which insures an even distribution of material. The drum itself and the driving motor are enclosed in a sheet-metal box for protection against dust. The motor drives all of the movable parts of the apparatus through belts. Before the reclaimed iron is passed to the delivery chute it is conveyed over a shaking sieve which frees it from dust and dirt. This plant is capable of handling 140 cubic feet of waste per hour. When operating at capacity it requires the services of two men to handle it satisfactorily.

Many of the large German foundries now are engaged not only in working over their own waste products but in reclaiming the iron from old dumps as well. There are some plants in operation at present in which waste iron is being recovered at the rate of 10,000 tons per year. In these large plants, the material is delivered in railway cars, after which it is handled in the usual way by elevators, magnetic separators, screens, etc. The iron usually is sorted into different sizes by screens, in order that the higher prices ruling for larger sized scrap may be obtained. This reclaimed iron, which is called *Abfalleisen*, was selling recently for 1500 marks per metric ton.

Specifying Malleable Iron for Castings

BY ENRIQUE TOUCEDA

IN GENERAL, the selection of the proper ferrous casting for use in a given piece of construction is dependent upon: Ability to successfully withstand the abuse to which it will be subjected in service; high rate and dynamic strength, which implies minimum sections for the strains involved, this in turn implying low cost for raw castings, as such are not only less costly in direct proportion to their strength, but their appearance is enhanced thereby; ease of machining, accompanied by a good surface on faced and turned parts, and freedom from unsoundness; which implies beauty of finished castings and low cost due to less loss from defective castings, and smoothness of surface, and trueness to pattern.

In discussing the foregoing a fact should be remembered that is frequently overlooked, namely, that the gray iron, the malleable iron and the steel casting have each a legitimate field of their own quite sharply defined by virtue of certain peculiarities possessed by each particular product. If a bedplate is desired for a certain large and ponderous machine, so dimensioned as to possess sufficient mass to enable it to absorb vibration, it would be unwise to specify that it be made of malleable cast iron. The malleable-iron founders are not at the present time equipped to cast and anneal castings of such size, and as cheapness and weight—obviously not high strength per square inch—are the dominant requirements in this case, the malleable iron casting should not be specified.

In commercial practice the engineer who has placed his contract with a reliable foundry can depend upon a uniformity of product that will rarely have a yield point lower than 31,000 pounds per square inch and frequently as high as 33,000, an ultimate strength less than 50,000 pounds, or an elongation less than 10 per cent. He can quite safely depend upon the integrity of the casting, for the reason that the founder has finally learned through costly experience that freedom from shrinkage depends not only upon correct gate emplacement, but more particularly upon the use of large shrink heads, so located as to eliminate such defects. Castings have been produced commercially as long as 5 feet, with sections at some parts as thick as 3 inches. In regular practice castings varying in weight from 300 to 500 pounds are made daily.

Generally, gray iron castings run heavier than do those made of malleable iron. Consequently there is less sprue and therefore less remelt. Also there is less variation between the composition of the sprue and that of the charge and as a consequence a much larger percentage of scrap can be used in the mixture when making gray iron than is possible in the case of the malleable castings. Assuming the highest fuel ratio in each case, 10 of iron to 1 of coke for the cupola, and 3 of iron to 1 of soft coal in the air furnace, it will be seen that the cost for fuel is less in the former than in the latter case. The same holds true in connection with furnace maintenance. Aside from cleaning and chipping, the gray iron casting is finished when the metal fills the mold, while the white iron castings must be cleaned, taken to the annealing room, packed in saggars, and then charged into the annealing oven and heat treated for a period in most instances of seven days. The saggars must then be removed from the annealing oven, the castings again cleaned and sorted, to the cost of which must be added that of the fuel used for heat treatment, oven maintenance, supervision, and overhead. It can therefore be very easily seen that there must be considerable difference btween the cost of production of these two products. The writer believes that on an average it will easily cost 1 cent a pound more to produce malleable iron than it will the gray iron castings, and at least 30 per cent more to produce steel castings than malleable.

The malleable iron casting is regularly used and can be recommended in the fabrication of railway cars, agricultural implements, motor vehicles, tractors, link belts, chain, fittings, stoves, etc., and is adapted for use for any part of such size as can be successfully made where strength combined with ductility is a necessity and low cost per pound an essential qualification of the product.

From a paper presented at a recent meeting of the American Society of Mechanical Engineers. The author, Enrique Touceda, is a consulting engineer, Albany, N. Y.

A. S. T. M. Changes Specifications

System of Nomenclature for Nonferrous Alloys Is Advanced — Allowable Sulphur and Phosphorus Limits, Increased for Steel Castings in 1918, Will Be Retained Another Year

PROPERTIES of and specifications for cast metals received attention at the twenty-third annual meeting of the American Society for Testing Materials held at Asbury Park, N. J., June 22 to 25. Malleable iron was discussed in a paper on the effect of machining and cross-section on the tensile properties of malleable cast iron, by H. A. Schwartz, National Malleable Castings Co., Indianapolis. This paper which gives a large number of results of tests was presented in the July 1 issue of THE FOUNDRY. There was no report to the general meeting by the committees on gray iron and on malleable iron, but both of these committees held meetings during the convention. The committee on gray iron, Richard Moldenke, Watchung, N. J., chairman, discussed the advisability of formulating a specification for high-test gray iron. This duty will be referred to the subcommittee on general castings, which will outline a specification to be considered by the whole committee. The malleable committee, H. E. Diller, chairman, THE FOUNDRY, Cleveland, last year brought to the society for adoption a specification for general malleable iron castings where high strength is required. Having had this specification adopted as standard the committee did not propose changes at this time.

The committee on methods of sampling and analysis of coal, S. W. Parr, chairman, University of Illinois, Urbana, Ill., and the committee on coke, Richard Moldenke, chairman, submitted brief reports. Both of these committees recommended the standard sieves recently promulgated by the bureau of standards be substituted in their specifications for sieves previously specified.

The formation of a joint committee on steel castings for railroads was announced by committee A-1 on steel. This joint committee consists of representatives of the American Society for Testing Materials, the mechanical section of the American Railroad association, and the United States railroad administration. F. M. Waring, Pennsylvania railroad, Altoona, Pa., is chairman of the joint committee and J. C. Davis, the American Steel Foundries, Chicago, has been elected chairman of the American Society for Testing Materials representatives. It is hoped that the committee will make it possible to [illegible] specifications in 1921.

The rejection limits for sulphur in both basic and acid cast steel and for phosphorus in acid steels had been increased 0.01 per cent above the values given in the specifications, by the society in 1918 and it was thought that this allowance would be removed this year. However, the committee on steel decided that the conditions which caused the adoption of this increased allowance have not yet returned to normal and it was decided to allow the increased limits for another year. The committee proposed a number of changes in the tentative specification for cast steel chain. All of these changes were adopted and the specification will remain as tentative for another year.

PRACTICALLY every industry in the country using or supplying materials is vitally interested in the proceedings of the American Society for Testing Materials. The specifications of this society are being used throughout America and even abroad as exporters recently have found. This society has adopted specifications for many kinds of castings including those made from all varieties of metals. The proceedings of the recent meeting here are given in full as they relate to the foundry industry, and they show the broad scope of the activities of the society in this field.

A paper on molybdenum as an alloying element in structural steels, by G. W. Sargent, Crucible Steel Co. of America, Pittsburgh, showed possible advantages of this element for additions in casting metals. Discussing the paper the author said that molybdenum in gray iron tended to change the structure of the free graphite and to increase the strength of the iron.

A start was made in formulating standard nomenclature for the more than 500 different nonferous alloys in industrial use, in the report of committee *B-2* on nonferrous metals and alloys. The terms are put forth for criticism by societies and individuals and the executive committee of the society has been asked to transmit the report to the British Institute of Metals for its comment. The system of nomenclature is based partly on color classification as may be noted in the following list, which includes all the terms so far proposed:

BRASS

The term *yellow brass* shall be used for zinc-copper alloys only, containing from 63 to 80 per cent copper and having a yellow or brass color.

Example: Composition of alloy: Zinc, 30 per cent; copper, 70 per cent.
Systematic name: Zinc-copper.

The term *red brass* shall be used for zinc-copper alloys only, containing more than 80 per cent copper, in which the color varies from a golden to a copper red.

Example: Composition of alloy: Zinc, 15 per cent; copper, 85 per cent.
Systematic name: Zinc-copper.

The term *yellow-red brass* shall be used for zinc-copper alloys only, containing from 55 to 63 per cent copper, in which range the brass has a yellowish red color.

Example: Composition of alloy: Zinc, 40 per cent; copper, 60 per cent.
Systematic name: Zinc-copper.

Lead brass.—Brass containing more than 0.50 per cent of lead shall be known as *lead yellow, red,* or *yellow-red brass,* according to the percentage of copper it contains.

Example: Lead-yellow brass.
Composition of alloy: Lead, 1 per cent; zinc, 33 per cent; copper, 66 per cent.
Systematic name: Lead-zinc-copper

Tin brass.—Brass containing more than 0.25 per cent tin shall be known as *tin yellow, red* or *tin yellow-red brass,* according to the percentage of copper it contains.

Example: Tin-yellow brass.
Composition of alloy: Tin 0.50 per cent; zinc, 39.50 per cent; copper, 60 per cent.
Systematic name: Tin-zinc-copper.

In cases where other metals are added, these shall be designated by the use of the proper prefix or prefixes:

Example: Manganese-tin-brass.
Composition of alloy: Manganese, 0.50 per cent; tin, 1 per cent; zinc, 38.50 per cent; copper, 60 per cent.
Systematic name: Manganese-tin-zinc-copper.

BRONZE

The term *bronze* shall be used for tin-copper alloys only, containing over 50 per cent copper. In cases where other metals are added these shall be designated by the proper prefix or prefixes:

Example: Aluminum-bronze.
Composition of alloy: Aluminum, 3 per cent; tin, 5 per cent; copper, 92 per cent.
Systematic name: Aluminum-tin-copper.

CUPRO-NICKEL

The term *cupro-nickel* shall be used

for nickel-copper alloys in which copper predominates. In cases where other metals are added these shall be designated by the proper prefix or prefixes:

Example: Iron-manganese-cupro-nickel.
Composition of alloy: Iron, 1.5 per cent; manganese, 2 per cent; copper, 67 per cent; nickel, 29.5 per cent.
Systematic name: Iron-manganese-nickel-copper.

NICKELENE

The term *nickelene* shall be used for nickel-zinc-copper alloys only. In cases where other metals are added these shall be designated by the proper prefix or prefixes:

Example: Lead-nickelene.
Composition of alloy: Lead, 1 per cent; nickel, 5 per cent; zinc, 31.50 per cent; copper, 62.50 per cent.
Systematic name: Lead-nickel-zinc-copper.

F. L. Lasier, connected with the bureau of construction and repair of the navy department, Washington, disapproved of the color classification. This bureau has suggested to the committee, the classification of the alloys alphabetically, such as brass *A*, brass *B*, etc., but the committee had not favored this proposal.

The committee proposed revisions in tentative standards for lead, for aluminum ingots for remelting and for rolling; and for methods of chemical analysis of alloys of lead, tin, antimony and copper. The committee also proposed tentative specifications for sheet high brass; and for aluminum for use in manufacture of iron and steel. Tentative standards; methods for battery assay of copper; and methods for chemical analysis of pig lead, were recommended to the society for adoption as standard specifications. All of these recommendations of the committee were adopted at the meeting.

A highly technical paper involving a great amount of microscopic research was presented by William Campbell, Columbia university, New York. This paper dealt with the constituents of certain brasses and bronzes as influenced by the composition of the alloys. The importance of the paper was emphasized by G. H. Clamer, Ajax Metal Co., Philadelphia, who said that it explained why bronzes with high tin content become hard and brittle when a large amount of zinc is present, and showed the necessity for increasing the copper when an increased amount of tin is present.

Results of fatigue and impact tests of aluminum alloys are shown in a paper by W. A. Gibson, Aluminum Castings Co., Cleveland, and comparisons are made with various grades of steel.

A new method of testing galvanized coating, by which the sample is not destroyed, was described by Allerton S. Cushman, Institute of Industrial Research, Washington. This method is based upon the measurement of the amount of hydrogen generated when a sample of a definite area is subjected to the action of concentrated hydrochloric acid to which a small amount of antimony chloride has been added. Apparatus has been devised for covering a portion of the sample with a tinned iron ring. This ring is closed at the one end by a soft rubber stopper, thereby making a cell into which the acid solution can be run. The evolved hydrogen is carried to a measuring burette by a tube, controlled by a 3-way stop cock. A tight contact is preserved between the bottom of the metallic ring and the galvanized surface by a plastic molding clay placed around the joint. The chief advantage of the method is that galvanized culverts or other objects may be tested without destroying the sample. They may be tested at different spots and the test can be carried on after the culvert is installed if desired. Spots made by the acid may be regalvanized or painted to preserve the steel. The results of Mr. Cushman's investigations show the method to be accurate and to give concordant results. Small samples may be tested by placing them in a cell formed by the apparatus against a material which is not attacked by the acid. In this method the results can not be reported as zinc per square foot but the total amount of zinc on the samples can be ascertained.

Columbus Convention Will Be Largest Ever

It is evident that the annual convention and exhibition to be held under the auspices of the American Foundrymen's association at Columbus the week of Oct. 4 to 8 inclusive will be the largest and most comprehensive affair of that character ever attempted in this country. The Philadelphia meeting of last year created a record both for the number of foundrymen in attendance and the number of exhibitors. Already, three months before the date set for the Columbus convention the total amount of exhibition space reserved and contracted for is over 51,000 square feet or within less than 9000 square feet of the total area in use at the Philadelphia exhibition.

Last year's exhibitors to the number of 141 already have made their space reservations. These, with 85 additional who make up last year's total and who have merely deferred making application and the number of new manufacturers who undoubtedly will take advantage of this occasion lends evidence to the belief that the Columbus convention and exhibition will be the banner event in the history of the association.

So far as possible exhibitors are given the locations they prefer; but this is sometimes physically impossible. The different power driven units must be grouped together where power is available. A floor plan of the buildings and also a plan showing the location and character of the different available power units has been sent to all prospective exhibitors. Copies of the plans and any other information may be secured from C. E. Hoyt, Marquette building, 140 South Dearborn street, Chicago.

Will Make Abrasives

The M. T. K. Sales Corp. has been organized at Rochester, N. Y., and incorporated under the laws of New York state to distribute a new bearing abrasive which is intended to eliminate the necessity of scraping bearings. The product is manufactured by the M. T. K. Products Co., Seattle, which, it is understood, contemplates moving its plant to the east in the near future. It is said that the abrasive will not cut iron or steel and hence will not injure shafts or other working parts, and after a few minutes of cutting, it breaks down and becomes a harmless residue incapable of further cutting. The officers of the M. T. K. Sales Corp. are: President, Benjamin C. Mathes, Mathes Sales & Mfg. Co., Rochester; vice president and consulting engineer, William D. Jones, formerly of the Symington-Anderson Co.; secretary, Willis P. Anderson; treasurer, Averill B. Pfeifer.

Study Microstructure

The results of a study of the microstructure of iron and mild steel at high temperatures are published in scientific paper No. 356 of the bureau of standards. It was found that when polished metal specimens are heated in vacuo. a record of structure which exists at the particular temperature used is inscribed on the polished surface of the specimen.

Charles H. Small recently has withdrawn from the firm of Small, Shade & Co., San Francisco, to establish a business of his own for the sale of railway industrial mining and marine equipment. Mr. Small previous to the war was connected with the American Brake Shoe & Foundry Co., at the Mawah, N. J., plant, and was representative for that company at the Panama-Pacific exposition in 1915.

Attaining Steel Casting Quality

British Practice Recognizes Need for Co-operation Between Foundrymen and Engineers—Changes in Design Recommended to Meet Shrinkage Troubles Encountered in Cooling

BY GEORGE F. PRESTON

STEEL castings are used exclusively for diverse purposes. Some difficulties which have arisen in the foundry have been due to the nonappreciation of the fact that, at the recalescence point Ar_1 in the cooling curve of steel, contraction is arrested and an actual expansion takes place. In an ordinary 0.3 per cent carbon steel the expansion between 690 degrees and 650 degrees Cent. is approximately equal to the amount of contraction between 790 degrees and 710 degrees Cent.; therefore in some castings of intricate design reversals of stress do not occur simultaneously in all parts. If such castings are left in the sand or on the floor, cooling at unequal rates in various parts, contraction will be taking place in some portions while in others expansion will occur, when adjacent members are in a plastic, or weak condition, resulting in cracks. When such difficulties due to reversals of stress occur, modification in design by the engineer, so as more nearly to equalize the thickness in critical parts, affords one means of remedy. Another is by *chilling* or using one of the various methods, not altogether favored.

Most steel-founders probably have experienced cases where the use of chills has been followed by cracks in the casting, through the effect of not having been fully considered. An alternative method which might be adopted for some castings is to arrange for the cooling from a temperature above degrees Cent. to take place in a preheated furnce, care being taken to shake out the casting at a temperature sufficiently above this to enable it to be sealed up in the furnace before the temperature has fallen to the danger point. This method was adopted with success in a casting for a ship of world-wide repute, having a heavy flange, or seating, about the middle of its length.

Cases occur where the engineer would be put to increased cost, or experience a difficulty, by omitting some portion objected to from the founder's standpoint, as, for example, in a cylinder or tube such as that shown in Fig. 1. This casting has a heavy flange, XX', 2 to 4 feet from the mouth, and used only for bolting the cylinder onto its base. The flange produces two difficulties to the makers. One is to feed the square flange to ensure soundness; the other, which is possibly of more consequence, is to prevent pulling in the bore of the cylinder about the center of the width of the flange at *A*. In such cases probably no objection could be raised to introducing in this heavy flange a frame Fig. 2, previously cast in steel, to act as a *chill*, thus equalizing the rate of cooling and also insuring an absence of cavities in the surrounding metal. There would be little theoretical and probably no practical loss of strength, for unless the chill was of excessive thickness it would to a large degree be fused by the fluid steel.

In important castings subjected to severe stresses, such as large gun mountings, the fullest and most careful consideration should be given by the designer to placing heavy masses or sections of metal where adequate arrangements can be made for feeding. In the absence of feeding heads, the thinner surrounding sections will *draw* on such reservoirs of molten steel and result in unsoundness or *piping* in parts where it is of the utmost importance that a large factor of safety should be provided.

A ship's stem might be instanced as an illustration of this important point. The position and size of necessary feeding heads to secure soundness, or, on the other hand, of alteration in design to obviate them, is relatively more difficult of general solution than the question of producing sound steel ingots. Such a ship casting usually has heavy brackets cast between the webs at the deck positions, thus further increasing the relative mass at these places. There is little doubt that a more satisfactory casting would result by breaking the continuity at the junction of the bracket with the section of the webs, particularly at the extreme forward point, as such recesses in the deck brackets can safely be filled in later by electric welding and caulked to make them watertight. If feeding heads are placed over these brackets, the steel will remain fluid at these places after the general contour of the stem casting has solidified, thus tending to unsoundness, distortion, and troubles through contraction. Another point which should be borne in mind in connection with castings of this type is that during the period of cooling the curved contour will tend to approximate a straight line. Allowance therefore should be

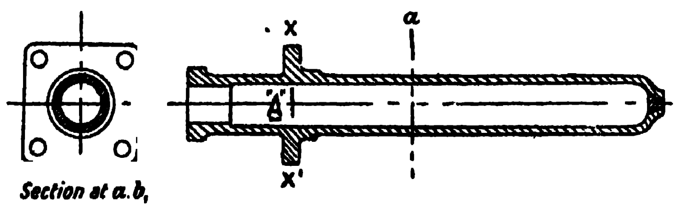
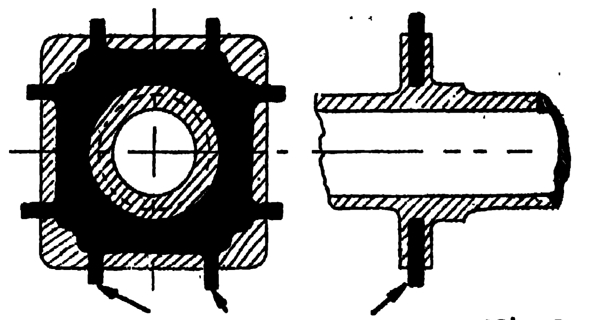


Fig. 1



The projections to be removed by chipping.

Fig. 2

FIG. 1—CYLINDER CASTING WHICH DEVELOPS PLANE OF WEAKNESS DUE TO COOLING STRAINS

FIG. 2—SUGGESTED USE OF STEEL CHILLS TO ELIMINATE DIFFICULTY SHOWN IN FIG. 1

...ted from a paper presented at a recent ... of the British Iron and Steel Institute.

made by the patternmaker for this tendency, particularly toward the ends.

Modifications in design would be more satisfactory in some of the cases, parts being made separately where possible. This has sometimes the objec-

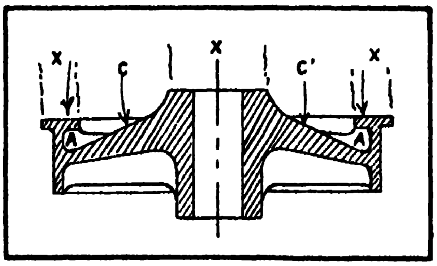


FIG. 3—CASTING WHICH HAS LIGHT RIBS TIED INTO INTERNAL FLANGES, PRODUCING SECTIONS WITH UNEQUAL COOLING RATES

tion of increase in cost of machining and handling, but cheapness should not be the sole consideration in making such castings.

Castings of the type shown in Fig. 3 sometimes are sought with light ribs, *AA*, tied under internal flanges and also to a heavy plate or cone center, *CC'*. Such ribs naturally cool at a much quicker rate than the heavy disk portion and feeding heads, *XX'*, and are therefore in considerable tension, where the members join the periphery, when the plate portion and the center boss have reached their maximum contraction.

It likewise is difficult to insure satisfactory castings of the design shown in Fig. 4. This shows a disk, or wheel, having spokes of heavy rectangular section on which are superimposed a plate of lighter section. Drawing, or other defects, probably will appear in the plate over the center of the spoke or rib, see *X* on section *ab*.

It must be admitted that a careful consideration by the management and a joint discussion with all foremen responsible for seeing work through the different shops would lead to the production of better castings; as it sometimes is seen, after a pattern is completed, that, if it had been made differently in some respect, to allow a modification in the method of making the mold, provision could have been made for more efficient feeding, and also for guarding against contraction.

Such expedients as inserting tubing of small diameter rammed with sand, in lieu of cores where they are surrounded by large masses of steel probably would then be arranged and much expense saved in cleaning and machining. It is well known that bent or broken cores cause endless trouble when the casting reaches the drilling machine; in fact, in many instances it would be far cheaper to omit small bolt-hole cores altogether.

Steel founders of repute have overcome the trouble of honeycombing and blowholes in castings. These, in earlier days, were considered almost unavoidable, in fact it has been stated in the past that the presence of blowholes might be taken as a "guarantee of quality in other respects!"

Given steel properly melted and with suitable percentages of silicon and manganese, and care in making and drying molds, little trouble is experienced from blowholes.

The elimination of honeycombing has resulted in largely increased productions of cast steel blanks for machine-cut gearing and similar castings, on which a large amount of machining is done. Such a defect is shown in Fig. 5. Arrangements should be made for the fluid steel to enter the mold at the bottom, and whenever possible a centripetal action, commonly termed *spinning*, should be secured. Suitable risers and feeders should be provided where necessary, to bring any dirt up into the heads. It usually is advisable to cast such articles quickly.

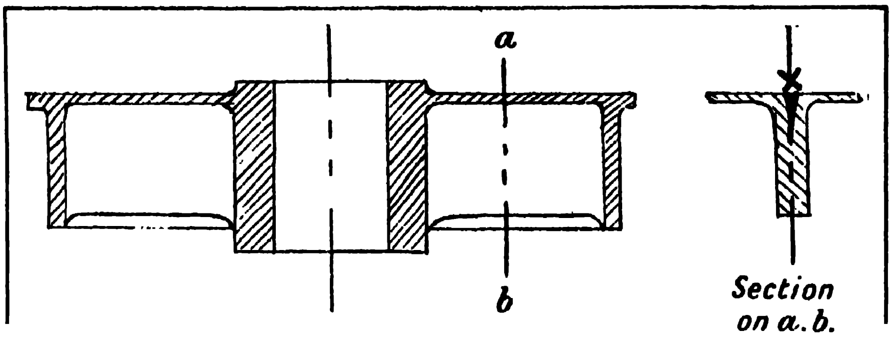


FIG. 4 WHEEL HAVING HEAVY RECTANGULAR SECTION WITH A PLATE OF LIGHTER CONSTRUCTION

Castings of this kind frequently are produced without the slightest defect, provided the design be favorable. One cause of trouble has been the attempt to supply blanks of fairly large diameter with solid disk, or plate, centers, which have a pronounced tendency to show cavities in the rim, practically in the position where the roots of the teeth are when these are milled out. This is due to the rim being heavier in section than the disk and therefore remaining fluid longer, and also, in cases where the change in section is not so great, to difficulty in arranging for adequate feeding at this place.

It is preferable to adopt H-section arms, but it is then found expedient to break the continuity of the metal at the junction with the rim by placing a narrow core through the webs of the arms. If objection be made to such a method resulting in any weakening of the casting, this easily can be obviated by increasing the strength of the faces, or top and bottom flanges, of the arms by having larger radii between them and the rim, as noted in *XX'*, Fig. 6, which is preferable from the founder's standpoint as well.

The same problems are encountered in the production of smaller castings, weighing from a few ounces upward, as supplied to motor and general engineering firms. The difficulties might be overcome in many instances if it were possible to arrange to submit suggested designs to some steel founder of good standing.

To give one example only: Axle-box guides for locomotives, still are made as shown in Fig. 7, *A*, which any user will understand generally results in drawing at *X* and *X'*, in addition to causing extra work in the machine shop owing to the absence of tool clearances, instead of a more gradual change in section and also of radii at the corners, as illustrated by Fig. 7, *B*, the more usual present design.

Innumerable examples might be added affecting practically every type of steel casting made, but the desire at the moment is to persuade the engineer that exchange of views is of importance not only in respect of the production of castings without inherent weaknesses, but also in regard to the use of differing qualities of steel, or of special alloy steels, for various purposes.

Providing suitable test bars, in the case of some forms of castings, is important if sound pieces for tensile and

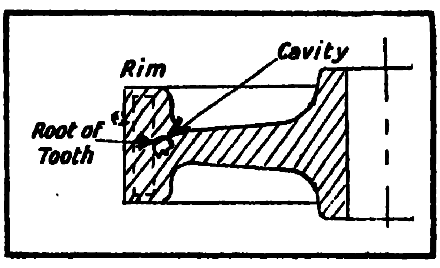
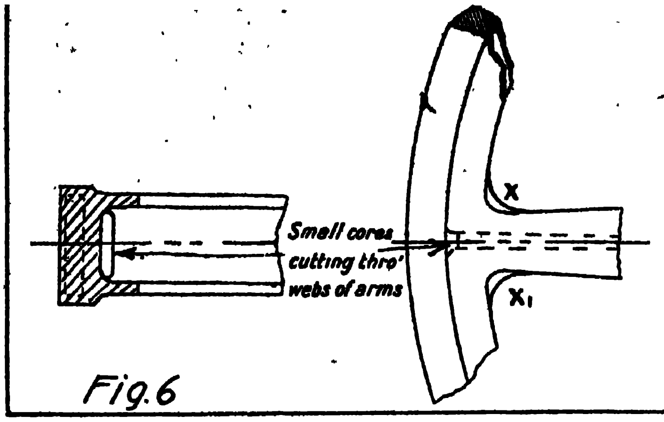


FIG. 5—DEFECT DEVELOPED IN A CAST GEAR BLANK—MACHINING ALONE WILL DISCLOSE THIS DESTRUCTIVE CAVITY

bend tests are to be insured. This should not be left to the discretion of the molder, who usually is governed by considerations of convenience in respect to the flask used for the [illegible] The question is well worth con[illegible]



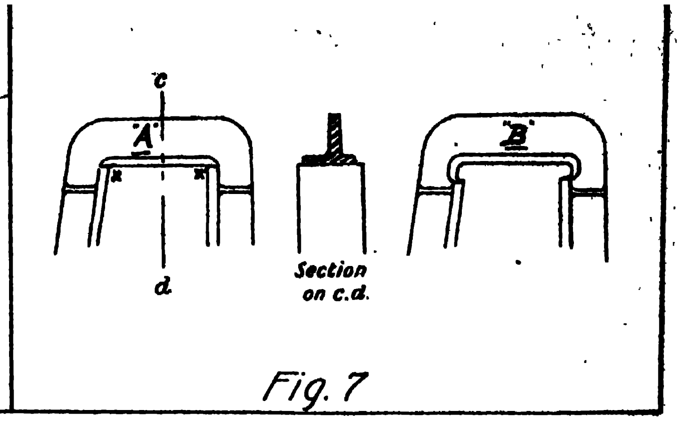


FIG. 6—SUGGESTED METHODS FOR OVERCOMING BREAKAGE BETWEEN WHEEL AND SPOKES, THROUGH USE OF SMALL CUTTING CORES OR LARGER FILLETS FIG. 7—REDESIGN OF LOCOMOTIVE AXLE-BOX GUIDES

tion by the management, owing to the loss incurred if a satisfactory casting be rejected solely through inability to obtain test pieces free from defects. In some cases, on cutting up a casting for test to represent others produced from the same cast of steel, or in breaking it under the drop hammer for remelting, it has been found that the casting was perfectly sound, defects appearing in the test pieces only.

It also is highly advisable to provide spare test pieces, as cutting pieces from rising heads often results in disappointment from causes such as segregation. Consideration should be given to such points as feeding the test bars, and whether the steel is able to flow freely through the part provided for tests. No dirt carried off the face of the mold, etc., should be trapped, and the test bar should not be sound at the expense of unsoundness in the casting itself, or *vice versa*.

For small castings it is advisable to treat the test bar as a separate casting but connected by a *spray* or runner of sufficiently large sectional area to ensure that the test piece is securely attached to the group of castings, or to the single casting, as the case may be, and also to give an adequate flow of steel into the test bar, on which a separate feeding head should be superimposed. A suitable design of test piece for this purpose is shown in Fig. 8.

When molds are made by machines, it will be found convenient to arrange the patterns on the plate, whenever possible, so that one or more patterns can easily be removed and a test bar included in place in several of the molds which will be put down for each cast. Special attention must necessarily be given to the method of fastening patterns to the plate to prevent any possible chance of displacement through frequent changing.

To ensure satisfactory test results it is necessary that the annealing or heat treatment should be carefully carried out. It is advisable to have some means for recording temperatures, readings being taken in various positions in larger furnaces until it is ascertained that a uniform heat is obtained in the particular type of furnace in use. The furnace attendant, if left to himself, often appears specially interested in recording flame temperature rather than those of the castings under treatment. If personal attention is given to this matter of heat treatment, economies in working, as well as higher quality material, may result, as small modifications in furnace design, for instance slight alterations in the sizes and positions of admission ports, may be found advantageous.

The most satisfactory furnace is one in which the rate of cooling down at the critical temperature can be varied, as then it is possible to obtain small variations in the maximum stress where castings are made to specifications.

Owing to the difficulty sometimes experienced in passing with reannealing

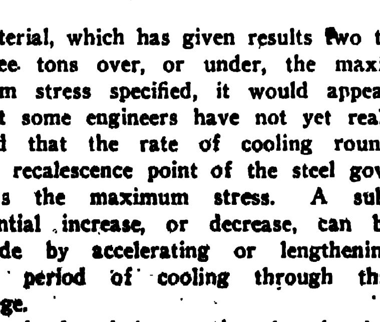


FIG. 8—DESIGN OF TEST PIECE WITH SEPARATE FEEDING HEAD

material, which has given results two to three tons over, or under, the maximum stress specified, it would appear that some engineers have not yet realized that the rate of cooling round the recalescence point of the steel governs the maximum stress. A substantial increase, or decrease, can be made by accelerating or lengthening the period of cooling through this range.

It is found in practice that heating to a temperature of about 950 degrees Cent. is advisable to insure *breaking down* the cast crystalline structure, the final structure being, of course, coarser or finer according as the rate of cooling through the critical range is slow or rapid. This temperature is much higher than is theoretically necessary, but experiments show the necessity for the higher temperature. The original crystallization of a casting will, of course, be governed by the mass of metal and the rate of cooling after casting. The length of time necessary thoroughly to soak castings and complete the *breaking down* throughout is a matter of judgment depending on size, thickness of metal, position the castings are loaded in the furnace, and other considerations.

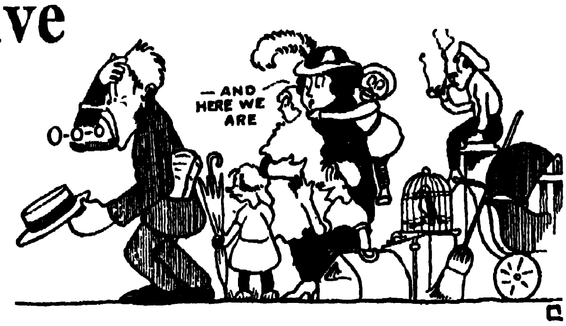
When dealing with large castings of heavy section it is advisable to pack them well up from the floor of the furnace. Pieces having heavy cores should be rough cleaned before being placed in the furnace.

Generally, if arrangements are made which will admit of castings being cooled quickly through the critical range without risk of distortion or setting up of stresses, through currents of cold air impinging on one part of a casting, an increase in the maximum stress without decrease in the elongation can be expected and, owing to the closer structure, better results from bend and shock tests will be obtained. Many cases have been noted where mild qualities of steel, as cast, have given practically the same maximum stress and elongation per cent as after annealing, for instance a breaking strain of about 97,000 pounds per square inch with 28 to 30 per cent elongation in 2 inches. However, untreated samples fail to give anything approaching satisfactory bend tests.

It is possible that manufacturers of high quality castings may soon consider that some form of shock test might not be against their interests if lower grade material, less suitable for the purpose required, and supplied at a cheaper rate, be in this way eliminated from competition.

Bill Makes Some Sheave Wheel Rigging

BY PAT DWYER

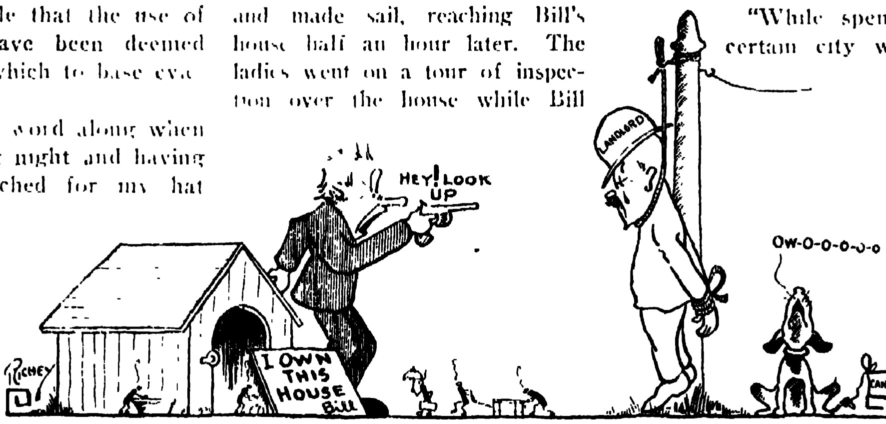


BILL has been so busily engaged in house hunting for the past few weeks that he had no time to spend an occasional hour in our midst. He called us up the other day and extended an invitation for Herself and myself to come over and see the *joint* he had landed. His intentions are of the best and his heart is in the right place but his use of the vernacular is sometimes startling, and in this instance would have given his new landlord heart failure if he had heard him. In fact under present conditions it is not at all improbable that the use of the term would have been deemed sufficient cause on which to base eviction proceedings.

I passed the good word along when I reached home that night and having finished supper reached for my hat and proposed that we start on the pilgrimage. We did eventually get under way, about an hour afterward. The members of the home guard were given such an extended and elaborate set of instructions on what to do and how to do it under any and all conditions, probable and otherwise that I finally was moved to suggest in a friendly way that we were not going on a tour around the world but in all probability would be back in about three hours. This well meant and totally disinterested observation was dismissed frigidly. I was told that it was a mercy and a special dispensation of Providence that I had some one who realized her obligations to look after the house and children. Furthermore, it was intimated that I had no conscience and it would serve me right to come home some night and find the baby hanging on the clothes line, the other children kidnapped and the house burned down.

I pointed to the fact that we had gone out together a million times, more or less, since we were married and none of these heart rending events had come to pass. With the mental dexterity peculiar to her sex, this little piece of logic, which I had confidently advanced with the expectation of justifying my position, was neatly turned to knock the props from under my contention. I was told that I had always found everything in a satisfactory condition on my return solely owing to the moral effect produced by the general orders which she always made it a point to issue before going away from the house for even the shortest time.

We finally heaved up the anchor and made sail, reaching Bill's house half an hour later. The ladies went on a tour of inspection over the house while Bill and I stayed on the verandah where he unburdened himself of his views on profiteering landlords and other classes of pirates who infest our fair land at the present time. I am willing to admit that I encouraged him shamelessly and shall always feel that I owe him a debt of gratitude for the able, skillful and whole hearted way in which he expressed sentiments which lie close to my heart. I always have felt a fear of employing Bill's flowing style due to an early training which taught me to expect that the direct consequences lay in the hereafter for those who used that kind of language.



WHY PAY RENT OWN YOUR OWN HOME -PLEASANT OUTLOOK AND AIRY DINING ROOM

"This moving business certainly gets me peeved," said he. "No sooner do I get fairly settled in a place than the bird who owns the house either sells it or jumps the rent to a point where if a man pays it he has to live on air. I am a firm believer in the 'Till death do us part,' form of marriage contract but sometimes I wish I was back again in the old carefree happy days when I skipped blithely from one boarding house to another and had nothing to pack but a trowel, a double ender and a few long lifters. When I moved from place to place on the foundry circuit, I had nothing to trouble me. I had a good time, plenty of money for my immediate needs. I had the opportunity of satisfying my young and ardent curiosity and I picked up some interesting pointers on the foundry business as I went along.

"While spending a season in a certain city which modestly hides its charms under a canopy of smoke, I discovered several new wrinkles in the molding of sheave wheels. 'Tis true I did not work or visit in every shop in the town for when the hot weather arrived I migrated to a more congenial climate. However, I saw enough of them and their practice to convince me that there are almost as many ways of making sheaves in that town as there are varieties of pickles put up in its famous pickle foundry. The name of the city is immaterial, but if I were to hint that it is situated at the junction of two rivers in a great coal producing state you would probably be able to guess the name before exhausting more than two-thirds of the letters in the alphabet."

"Oh, cut out the circumlocution," I said. "I know the city you are talking about; it is down in a valley and the people have to climb a hill a mile high when they want to see the sun."

"Have it your own way," said Bill. "Not being either a mountaineer or a billy goat, I never saw the sun while I was there so you probably are right. I have done so much prowling around dark foundries all my life that I noticed whether the sun was

in Pitts—Oh, well! Let it go at that, the question of sunlight has nothing to do with the story anyway.

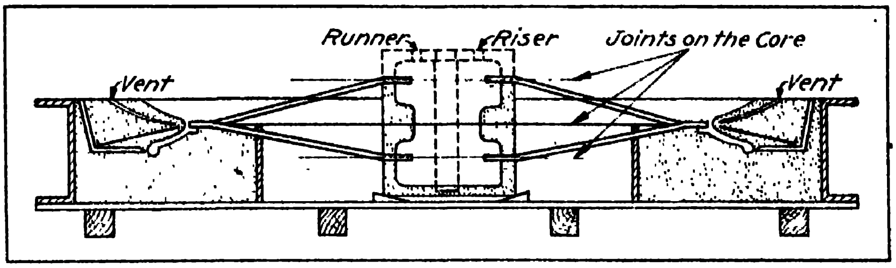
"I worked in one shop where they made great numbers of sheave wheels of all sizes and some of the rigs in use were certainly time and labor savers. One rig in particular for making 4, 6 and 8-foot wheels appealed to me and I made a similar set of rigging for the same class of castings in a shop I had charge of later.

"The sheaves to which I have reference are those having wrought iron or steel spokes attached to the hub and rim after the manner of bicycle spokes. The hub is long and while the spokes enter the rim on the same horizontal plane as the joint of the pattern, they enter the hub alternately up and down; that is half the total number of spokes enter near the top of the hub and the other half enter near the bottom. Owing to the contraction of cast iron the hub cannot be poured until the rim has cooled and contraction ceased. Therefore, it is customary to pour the rim in one day and the hub on the next.

"The rim of a 6-foot wheel will contract approximately 3/4-inch which means that the inner ends of the spokes will be 3/8-inch nearer the center of the casting than they were when they were placed in the mold. The hub of the same wheel generally is about one foot in diameter having a total shrinkage of 1/8-inch. Therefore, it will be seen that the contraction at any point on the circumference of the hub is only 1/16 of an inch; an amount which serves only to put a slight tension on the spokes.

"Where great numbers of these wheels are made, it might be advisable to use iron patterns but under ordinary circumstances wooden patterns are quite satisfactory. They are more easily handled and with ordinary care will last indefinitely. I have a case in mind where the same wooden patterns have been in use for over 10 years. They have not been in constant use all that time but I should say off-hand that 100 wheels have been made off them each year during that time.

"For illustration, take a 6-foot wheel and consider in detail some of the pattern making and molding features. A full sized layout is made on the board and the necessary stock for the rim cut out and built up roughly to conform to the desired shape. The rim is built in two halves, dowel pins inserted in two or three places after which it is placed in the lathe and turned to the finished shape and dimensions. A thin wooden templet accurately made to conform to a sectional view of the casting is used to check the work as it progresses. After the rim has been turned and finished it is removed from the lathe and placed on a suitable bench where the hubs with prints attached for the spokes are fitted on. It is then given a couple of coats of black shellac varnish and is ready to go into the foundry for service.

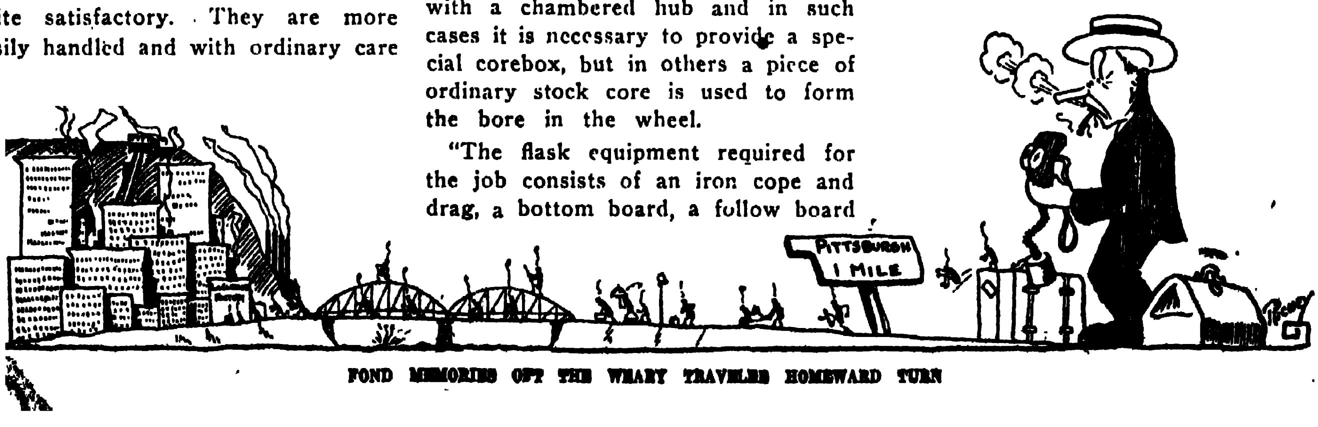


DRAG OF THE MOLD JUST BEFORE CLOSING DOWN THE COPE THE DOTTED LINES INDICATE THE APPEARANCE OF THE ASSEMBLED CORE ON THE FOLLOWING DAY THE LIFTING RING IS PROVIDED WITH THREE V SHAPED PROJECTIONS EQUALLY SPACED ON THE OUTSIDE FOR GUIDING IT INTO PLACE

"The hub of the wheel is made in a dry sand mold composed of four sections of dry sand cores. Since both halves of the hub are symmetrical, only two core boxes are needed. Two cores from each box make a complete hub mold, the top and bottom cores being made from one box and the two center sections made off the other. Some of these wheels are made with a chambered hub and in such cases it is necessary to provide a special corebox, but in others a piece of ordinary stock core is used to form the bore in the wheel.

"The flask equipment required for the job consists of an iron cope and drag, a bottom board, a follow board and an iron lifting ring for carrying the body of green sand which forms the groove in the rim of the wheel. As the rim of the wheel is the only part cast in green sand it is not necessary to ram any sand in the center of the flask. Both cope and drag are barred and consist of the ordinary style of flanged outside ring and a plain ring about 3 feet in diameter on the inside. The bars in the cope follow the parting line closely, but the bars in the drag are shallow and serve principally to support the center ring. The inside ring in both cope and drag is split to allow for contraction. The follow board is made to conform to the shape of the pattern and also provides a depression around the perimeter of the wheel to form a seat for the lifting ring. This part of the drag is rammed hard and there is no need to go over it with a trowel to make a parting after the drag has been rolled over. In making the mold the follow board is placed on the floor in the usual manner; care being observed to see that the battens are bearing. These boards usually are stiff but unless they are evenly supported underneath, the force of the ramming will throw them out of shape and produce a distorted wheel. The pattern for the wheel rim is then set in its place after which the drag is lowered into position.

"Under ideal conditions it might be possible to ram the drag and roll it over without using a bottom board but in actual practice it has been found more convenient to clamp a bottom board on the drag before rolling it over. One reason for this is that the bars in the drag, to facilitate ramming, are spaced further apart than the bars in the cope. In fact some drags are provided with only four bars or just enough to hold the inside ring in posi-



FOND MEMORIES OFT THE WEARY TRAVELER HOMEWARD TURN

tion. After the drag is rolled over and the follow board removed, parting sand is sprinkled over the flat seat for the lifting ring and the latter set in place. Facing sand is riddled on and a number of long spikes, pointing toward the center of the wheel, laid closely together around the rim. The other half of the pattern is then set on and sand shoveled in until the space between the pattern and the lifting ring and also the space between the lifting ring and the wall of the drag are completely filled. The sand in the groove is tucked lightly with a hand rammer and the fingers, but the remainder of the sand is rammed quite firmly.

"A parting is then made flush with the joint of the drag and depressed a little at the edge of the bead which encircles the rim of the pattern. The cope is set on and four gate pins located; two for runners and the other two for risers. Four long wood screws also are inserted in the pattern, their upper extremities protruding above the cope, before any sand is shoveled in. When this precaution is not observed the pattern is soon filled with holes.

"Before lifting the cope a rod is passed through the eye of each of these screws and tightened with a wedge. When the cope is lifted the upper half of the pattern comes with it. The cope is rolled over for finishing and then the lifting ring carrying the groove of the wheel is taken out of the drag. To get an even tension on the ring, turn-buckles are attached to the end of the crane chains. The lower half of the pattern is drawn, the mold finished and the lifting ring lowered back into position.

"The cores for the hub are set by taking the first pair and wedging them up level with the parting line of the mold. Channels are cut with a gate cutter for each alternate spoke from the ends of the prints to the openings in the inside drag ring after which the arms are set in place. The mold then is closed and made ready for pouring. On the following day the cores are reassembled, clamped together and the hub poured. It is customary to run some metal through the riser or flow-off in case the iron should kick or blow off the ends of the arms."

"I should like to hear some further details," I said, "but I hear the sound of fairy footsteps approaching and you know what that means."

"Good bye," said Bill; and then he added reminiscently, "Yes, sir, Pittsburgh was certainly some town in those days."

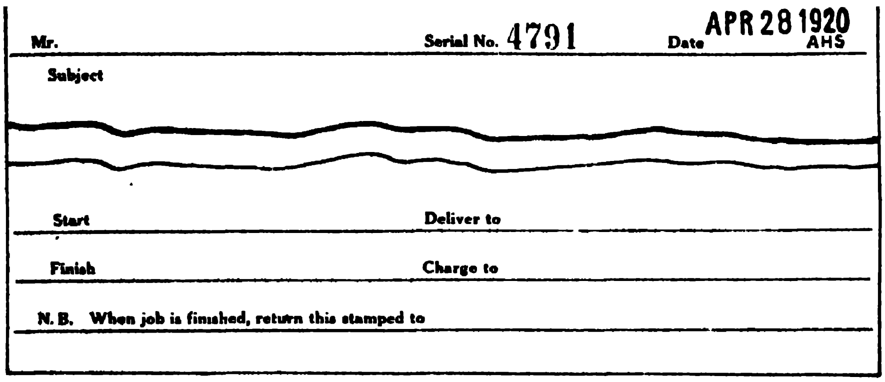
Verbal Orders Tabooed in Small Shop

Large manufacturing companies generally appreciate the advantages of written orders. One establishment is so insistent on this point that it has printed in red ink at the top of all its internal forms *Verbal Orders Don't Go.* While the management in big plants generally insists on the use of written orders about the plant, the man who has a small shop and supervises all the work himself seldom regards this as necessary. He knows all the workmen personally and either speaks to the man whom he wishes to direct, or sends word to him by one of the other workers. This is the easiest way and if results always are satisfactory, there is no need of going to the trouble of writing instructions or directions incident to laying out the work.

However, it sometimes is found that the verbal order does not bring the desired results. Possibly the one directed forgets to do the work or he may misunderstand the order. Occasions like these have caused A. H. Smith, secretary and treasurer of the Hills-McCanna Co., Chicago, to adopt the policy of writing all orders for the shopmen. The company is an average medium sized brass foundry and Mr. Smith is superintendent. He comes into direct contact with all the workmen and easily could give verbal instructions, but he has found it advantageous to write all orders.

A consecutively numbered form such as the one shown in the accompanying illustration is used. The name of the man to whom the order is addressed is placed on the top line with the serial number and the date. The main body of the form is used to detail the work to be done. Below is space for stating the time the work is to be started and when it is to be finished. A space also is reserved so that the workman may be told to whom he should deliver the finished task. The job or department to which the work is to be charged is stated in the order on the line marked *charged to.*

These slips are made out in duplicate so that Mr. Smith may retain a copy. The copy is held until the original is returned by the man to whom it was given. This copy serves as a check and a reminder for the superintendent, who looks over the lot occasionally to see that no job is being slighted.


Mr. Serial No. 4791 Date APR 28 1920 AHS

Subject

Start Deliver to

Finish Charge to

N. B. When job is finished, return this stamped to

THE SUPERINTENDENT WRITES ALL ORDERS ON A SERIALLY NUMBERED FORM, KEEPING A DUPLICATE UNTIL THE ORIGINAL IS RETURNED SAYING THE JOB IS COMPLETED

Purchases Steel Foundry

The Interstate Foundry Co., 3161 E. 61st street, Cleveland, has purchased the Standard Steel Castings Co., 3311 W. 73rd street, Cleveland, according to F. B. Whitlock, vice president and general manager of the Interstate company, who also is president of the Standard company. The purchasing company has acquired the assets and assumed the liabilities of the other. The action of the directors of both companies has been ratified by the respective groups of stockholders. A meeting will be held shortly at which there probably will be some changes in the executive staff. The present plant turning out steel castings and Interstate officers will continue until then. For the present the output of both companies will continue as in the past, the Interstate foundry producing gray iron and semisteel castings and the Standard's Cleveland the Illinois plant motor truck wheels.

Consolidate Interests

The Hausfeld Co., and the Campbell Bros. Mfg. Co., Harrison, O., have consolidated their business interests, and will operate under the name of the Campbell-Hausfeld Co., effective July 1, and will continue to manufacture melting furnaces, and other foundry specialties as well as the Campbell corn, cotton and peanut planters. F. B. Hausfeld, is president, A. M. Campbell, vice president; Jos. E. Hausfeld, treasurer; C. E. Haddock, secretary; H. O. Campbell, purchasing agent, and J. S. Armour, sales manager.

FORMULAS FOR THE BRASS FOUNDRYMAN

RECENTLY PATENTED NONFERROUS ALLOYS

Aluminum-Manganese Bronze

The addition of manganese to aluminum bronze has been the subject of patents in most civilized countries. In Austria, F. Teltscher was awarded a patent on the following alloy:

	Per Cent
Copper	88 16
Aluminum	10.00
Manganese	1.20
Zinc	0.64
	100 00

Imitation Silver

Alloys having a silvery appearance afford a fertile field for inventors. The following example was patented in Great Britain recently by C. E. Monkhouse and M. H. Denton:

	Per Cent
Copper	69 50
Nickel	15 00
Zinc	8 50
Tin	4.50
Lead	2.50
	100 00

Another alloy which looks like silver, and is said to have the added value of being "noncorrosive," and which takes a high polish was patented by C. L. Jones in United States patent No. 1244742. The alloy follows:

	Per Cent
Nickel	67.80
Copper	28.00
Manganese	2.50
Iron	1 50
Vanadium	0.02

Another noncorrosive alloy is the following. It is to be used for electrical contacts. The alloy which is expensive follows:

	Per Cent
Platinum	45.00
Silver	25 00
Gold	15.00
Copper	15.00
	100.00

The patent is United States No. 1101534 and the patentee R. B. Graf.

FORMULAS FOR THE BRASS FOUNDRYMAN

RECENTLY PATENTED NONFERROUS ALLOYS

Manganese Bronze

A method of making manganese bronze using a special hardener was patented in Great Britain by F. Heusler and the British Mining & Metal Co. The specifications cover an alloy containing from 15 to 20 per cent manganese; 5 to 15 per cent aluminum, and small quantities of lead, tin, nickel, cobalt chromium and other metals. The following alloy is preferred for the hardener:

	Per Cent
Copper	63.00
Manganese	25.00
Aluminum	10.00
Iron	2.00
	100.00

The manganese bronze is made as follows:

	Per Cent
Copper	54.00
Hardener	6.00
Zinc	40.00
	100.00

The finished manganese bronze would have approximately the following analysis:

	Per Cent
Copper	57.78
Zinc	40 00
Manganese	1.50
Aluminum	0.60
Iron	0.12
	100.00

In making the alloy it would be necessary to allow about 1.5 per cent excess zinc to compensate for volatilization, also in remelting further additions would have to be made. The manganese, aluminum and iron would be diminished by oxidation in making the alloy.

The above patent also specifies an alloy for bearings. In this alloy the manganese bronze hardener is used as a deoxidizer. The bearing alloy follows:

	Per Cent
Copper	83.00
Tin	9.00
Zinc	6.00
Hardener	2.00
	100.00

Presents Theory on Oxygen Cutting

Cast Iron Has Resisted the Application of Oxygen Welding and Cutting Processes —A Consideration of Metallurgical Properties Points to Physical Causes

BY F. J. NAPOLITAN

FROM the ease with which wrought iron is cut, it may be concluded that an aggregate of ferrite combines with oxygen with greatest avidity, and permits propagation of a cut with least interruption. As the carbon content is increased, there is a material change in the nature of the metal. In place of the preponderance of ferrite grains, the formation of cementite is recognized and its union with some of the ferrite to form pearlite—the original mass of pro-eutectoid ferrite rapidly diminishing in prominence. As anticipated from the nature of pearlite, no material change is noticed in the performance of these alloys under the cutting torch. Of course, an ultra-precise consumption test probably would indicate a lowering efficiency coefficient, but from all appearances, no unusual difficulty is experienced in cutting carbon steels up to about 80 to 90 point carbon. However, a definite transition is indicated here by a distinct laboring of the cutting torch. While the torch will begin a cut with practically the same effort, and proceeds to completion without interruption or unusual delay, yet the kerf is wide and ragged and undeniably distinguished from that of a mild steel cut. It is recognized practice, now, to preheat the piece to be cut to a black or dull read heat, when the impediment, whatever it was, seems to have been entirely eliminated.

Metallography explains the sudden change of properties in the steel. As the carbon content of the hyper-eutectic steel was increased, the proximate mass of pearlite increased, and the pro-eutectoid ferrite correspondingly diminished in volume, until eventually, a point was reached where all of the cementite and ferrite existed in the stratified or laminated relationship of pearlite. This state is recognized as existing where the carbon content is between 80 and 90 point—the approximate analysis of pearlite is yet undefined. As the carbon content is further increased, there appears a constituent known as pro-eutectoid cementite—in fancy, the cementite which has been ejected from the pearlite growth. It is circumstantial that the presence of this pro-eutectoid cementite is directly responsible for the increasing difficulty of cutting. Why did preheating the steel before cutting make such a remarkable difference in the results? To be sure, the rise in temperature might affect the stability of any martensite, troostite, or even sorbite that might have existed, but the temperature was too far removed from the Ac_{321} point to affect the characteristics of the pearlite.

> *MOST of us have expressed at some time or other the solemn opinion that 'cast iron could not be cut, because the oxide of iron melted at a temperature higher than cast iron itself. Not only does cast iron burn to form an oxide, but the higher melting point of the oxide probably assists the reaction. While we are rather skeptical of the commercial value of a cast iron cutting torch, and are convinced that, financially, we will never be repaid for the expense of our experiments, yet there are undoubtedly occasions when the cutting of cast iron would be of great value.*—Stuart Plumley.

Surely the pro-eutectoid cementite was unchanged—and it was this same constituent that was blamed for the difficulty.

Again, as the carbon content is substantially increased, an equivalent interference with cutting is apparent, until, when the carbon content approaches 2.5 per cent, cutting becomes so labored as practically to cease, and no amount of preheating short of incipient fusion will permit it to proceed. The metal now is termed *cast iron*, and a micro-analysis indicates that in addition to the presence of a certain amount of pearlite and pro-eutectoid cementite, as well as certain foreign and unobtrusive substances, the presence of the final and most stable state of carbon, graphite, is recognized. The pearlite constituent exercises a favorable influence upon the cutting operation and the pro-eutectoid cementite, while it impedes cutting, is readily compensated by a slight preheating. However, the graphite presents an entirely new problem.

One of the stereotyped explanations of why cast iron cannot be cut, that the melting point of the slag is appreciably higher than the melting point of cast iron, is a fallacy. A micro-analysis of the structure of an average cast iron of about 3 to 4 per cent carbon—would indicate a structure identical with that of a hypothetical steel of the same carbon content, except that some of the carbon seems to have been precipitated as graphite. Should that identical pour of cast iron have been cast against a cold iron mold, or otherwise chilled, the carbon would not have been precipitated as graphite and the metal would have been called a *chilled cast iron*, or a *white cast iron*. It would actually have been a hyper-eutectic steel. Such alloys are not uncommon in commerce, and the fact that operators have been able to cut them with no extraordinary effort, has been responsible for innumerable false claims that cast iron has been cut. Unfortunately, the nomenclature of steels and irons is not clearly defined, and undoubtedly, a chilled cast iron is but an extension of the hyper-eutectic series. The melting point of an iron-carbon alloy is a constant of its composition, whether, in the solid state, the metal exists as a typical cast iron or as a steel. Long before the point of fusion, the carbon and the iron exist in one relationship, that of austenite. The conditions affecting the pouring of cast iron determine the final state of its constituents, and it is possible to produce a gray cast iron or a chilled white cast iron, the carbon as graphite or the carbon as in cementite. In either event, the melting points of the resulting products would be identical. Chilled cast iron can be cut with comparative ease, notwithstanding that its melting point is lower than the melting point of the slag produced. It is evident, then, that the melting point of slag is not responsible for the difficulty encountered in cutting cast iron.

While the existence of pro-eutectoid cementite appreciably retarded cutting, the presence of but a comparatively small amount of graphite completely *prevented* cutting. The phenomenon, if it were

Abstracted from a paper presented at a recent meeting of the American Welding society. The author, F. J. Napolitan, is connected with the engineering research department, Davis-Bournonville Co., N. J.

true, is unique, for it would pre-suppose the incombustilibity of carbon. Science contradicts this immediately. The reaction accompanying the removal of carbon from automotive cylinders by the oxygen method and the explosive combustion of carbon in ordinary gunpowder are proof to the contrary. The conclusion is evident that far from retarding the combustion of the steel matrix, the graphite of cast iron should actually assist it.

The writer investigated further to determine how much graphite influenced cutting. Specimens of so-called malleable castings of the characteristic *black heart* structure were obtained. Such a structure is made in this country by the annealing of white cast iron in which all of the carbon exists in cementite or pearlite, the latter in some cases entirely removed. The treatment decomposes the cementite to precipitate the carbon in minute particles, differing from the graphite of gray cast iron in their extreme subdivision and uniform distribution throughout a ferrite matrix. In making a black heart casting, an oxidizing packing is used so that while the core is that of a black heart casting, the mass near to the surfaces is ferrite. This shell of ferrite was removed so that the materials indicated, under the microscope, a uniform aggregate of ferrite and temper carbon. By preheating this piece to a dull red heat, it was cut with the characteristics of a high carbon steel. This satisfactorily proved that carbon as such did not prevent cutting, but that the physical state of that carbon was responsible. As plates of graphite, cutting was prevented—but as finely divided particles, cutting was scarcely impeded.

Reconsidering previous observations in the light of this development, we began to substantiate our first logical hypothesis. We found, to summarize, that ferrite permitted the metal to be cut most readily. Pearlite with pro-eutectoid ferrite did not materially affect the conditions. A completely eutectic composition first suggested a transitory stage. The existence of pro-eutectoid cementite retarded cutting; but preheating of the piece to a red heat readjusted the conditions so that cutting was again as efficient as in the case of ferrite. As the comparatively low temperature produced by preheating was insufficient to effect any change in the physical state of the constituents of the alloy, it must be concluded that the addition of heat units affected a definite constant, which we assumed was the heat of combustion of the iron, as the two forces were of like characteristics. Then a constant result from a variable, made axiomatic the existence of a second variable.

The second variable, then, it was concluded, was the cooling effect of the stream of cutting oxygen, and a further thought suggested a third variable in the time of chemical reaction between the iron and oxygen. The preheating flames ignited the steel, the cutting oxygen produced combustion, and the propagation of the cut was a natural consequence. However, as the carbon content was increased, the speed of the reaction was materially lowered; but the velocity of cutting oxygen to insure a continuity of oxygen and slag to the bottom of the cut, was a constant. Eventually, a point was reached where the rate of combustion between the iron and oxygen was so slow that the heat units liberated from the reaction were dissipated to such an extent as no longer to ignite adjacent masses of metal—and cutting ceased. By preheating the piece before cutting, we added to the forces on the weakening side of the equilibrium, and cutting once more obtained. The heat units so obtained, compensated for the relatively less heat units liberated from the chemical combination of the iron and oxygen in a definite unit of time.

While the pearlite and pro-eutectoid cementite are readily compensated, the graphite carbon effectively prevents cutting by the ordinary means. No addition of heat units short of incipient fusion, by preheating the object, restores the equilibrium It was impossible to strengthen further, one side of the equilibrium, but no attempt had been made to affect the other side. We had made no effort to reduce the cooling effect of the cutting oxygen. Therefore, experiments in this direction demonstrated that we could so effectively preheat the cutting oxygen that we could restore the equilibrium without preheating the object.

Shot Iron for Use in Sash Weight Castings

Question: Please advise the best manner of using shot iron in the cupola. We have plenty of stove scrap and are of the opinion that if the stove scrap was charged first it would prevent the shot iron from falling through. We propose making sash weights from such a mix. What amount would you recommend for charging a cupola lined to 42 inches; how much coke between charges and how much limestone? Would there be any difference in the amount of beehive and by-product coke used for melting and does the former require a stronger blast than the latter?

Answer: There is considerable misapprehension in regard to the use of shot iron and small scrap from the cupola drop. When melted it is just as good as any other iron. The theory that shot iron works its way through the charge and is carried through the tap hole into the ladle and later into the casting will hardly bear investigation. It might happen but is highly improbable. The small hard lumps occasionally found in castings are due to entirely different causes which it is not necessary to discuss at present. The fact that such nodules of iron sometimes are found in castings poured from the best of pig iron and carefully selected scrap entirely disproves the shot iron theory. You will be perfectly safe in using shot iron and stove plate scrap in any proportion you please.

A cupola lined to 42 inches will melt satisfactorily on any charge from 1000 to 4000 pounds. The smaller the charge the hotter the iron. For the class of work which you propose to handle, which does not require hot iron, and taking into consideration the bulky nature of stove plate scrap, a 3000-pound charge should give the best results. Use 300 pounds of coke between the charges of iron and about 60 pounds of limestone. After running off a few heats you can vary these proportions a little either way. All coke and all limestone are not alike and it is impossible to lay down a hard and fast rule that will suit all localities.

The amount of coke on the bed will depend on the height of the tuyeres. Place enough coke on the bed so that when it has burned through and settled it will be about 20 inches above the tuyeres, then add 6 inches more of coke and proceed to charge the iron. The cupola should be filled to the charging door before starting the blower.

There is no appreciable difference between by-product and beehive coke when used in the cupola. Your cupola will melt about 8½ tons an hour and therefore you will need a blower capable of delivering about 5000 cubic feet of air a minute.

Purchases Truck Plant

The Yale & Towne Mfg. Co., Stamford, Conn., recently has purchased the Industrial Electric Truck division of the C. W. Hunt company, Staten Island, N. Y. Arrangements have been completed for increasing the company's manufacturing facilities at Stamford to care for the requirements of the new line.

The Diamond Oil Co., Philadelphia, recently has completed additions to its Philadelphia works, including the installation of machinery for treating linseed oil for cores.

New Annealing Oven Saves Heat

Continuous Tunnel Kiln Having Double Chambers With a Common Wall Between Reduces Radiation Surface—Cold Cars Enter One Chamber And Absorb Heat of Cars Coming From Opposite Chamber

SCARCITY of fuel of all descriptions is causing manufacturers to endeavor to conserve as much as possible and to seek more efficient methods of heating. The same problem was met in Europe years ago, but the procedure followed there did not at the time appeal to producers in this country where the fuel supply was plentiful. One of the steps taken to conserve fuel was the use of the tunnel kiln in place of the periodic oven for annealing malleable iron castings. The tunnel kiln permits the charge to be heated on entering at one end of a long tunnel and to be passed to the combustion zone in the direction opposite to that in which the hot gases of combustion are passing. The charge is carried on through the firing zone, usually by cars running on a track through the furnace, and then through a zone which is not heated but which is a part of the kiln and absorbs the heat from the charge as it cools. This method conserves fuel by extracting heat from the escaping gases and using it to heat the incoming charge. Also, tunnel kilns usually have less radiating space in the roof and walls than the several periodic ovens required to accomplish the same amount of work.

Continuous tunnel-type furnaces first were used in the porcelain industry. Later they were introduced for annealing steel and more recently for annealing malleable iron. Until lately all the tunnel kilns installed in this country have been of the type originated in Europe. However, recently an American firm, the General Combustion Co., Chicago, has designed a tunnel kiln embodying new principles. This is installed in an eastern establishment and is used for annealing sheet steel. The temperature requirements of this operation are quite rigid to assure the requisite quality and the tunnel kiln has turned out a finished product which is entirely satisfactory.

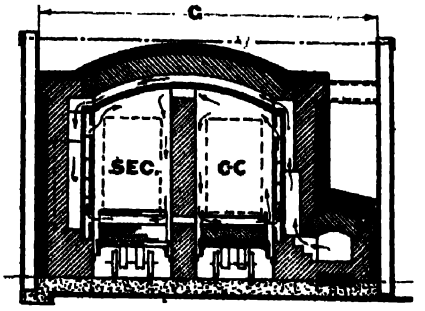
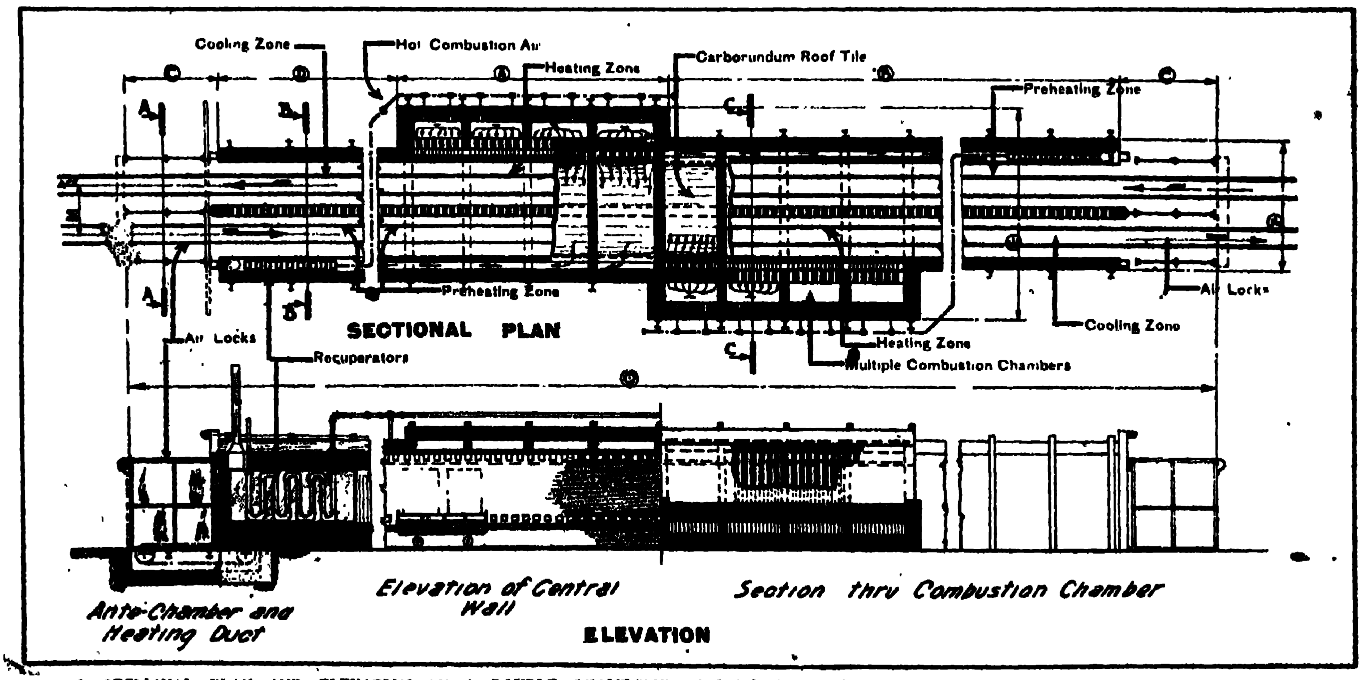


FIG. 1—CROSS SECTION THROUGH FIRING ZONE

The kiln of the General Combustion Co. is built under the Kirk patents. The novel feature is that the kiln is composed of two chambers built beside each other with one wall common to both. A plan of one of these units is shown in Fig. 2. The stock progresses through the two chambers in opposite directions, and in each one it moves opposite to the direction in which the burned gases are moving. This regulation is accomplished by having the two firing zones placed diagonally opposite to each other, as may be noted. A wall separates the flues of these two compartments. Fig. 1 shows a cross section of the kiln through the combustion chamber, the arrows marking the direction of travel of the gases. It will be noted that these products of combustion travel directly across the axis of the kiln instead of parallel to it. A number of combustion chambers are provided. The burned gases pass through a flue along the entire length of the wall of the furnace and preheat the incoming air to be used for combustion. This air passes along the same chamber through a line of cast iron pipe of special design.

The entrance end of one chamber is beside the exit end of the other chamber and the wall between is perforated at the top and at the bot-



2—SECTIONAL PLAN AND ELEVATION OF A DOUBLE CHAMBERED CAR TYPE, TUNNEL KILN FOR ANNEALING MALLEABLE IRON CASTINGS—NOTE THE FIRING ZONES OF THE TWO CHAMBERS ARE LOCATED DIAGONALLY OPPOSITE EACH OTHER

tom with a row of ports. With this arrangement the hot air from the annealed pots rises and passes through the upper ports to the chamber containing the cold incoming pots. Being cooled by these the air settles to the bottom portion of the chamber and is drawn through the ports at the bottom of the center wall to the chamber containing the hot pots. In this way the hot material assists in heating the cool incoming charges and these in turn increase the cooling rate of the pots containing the annealed castings.

The kiln is almost a perfect muffle and the charge is never subjected to the direct action of the flame. Little heat is allowed to penetrate underneath the cars, which have an effective seal between them and the walls. Therefore no elaborate method for cooling the bearings is necessary.

Antichambers are used at both ends to prevent air from entering the kiln when cars are charged or discharged.

The application of this kiln to annealing malleable iron is shown in Fig. 3, which illustrates the layout of an annealing room with two 40-ton continuous tunnel kilns. The actual length of this double furnace is 120 feet 6 inches, but it is stated that it will anneal as many castings as a single tunnel kiln 241 feet long. To anneal 80 tons of castings a day in a 6¼-day time cycle, with a 6-foot car carrying 6¼ tons of castings, 12.8 cars must be charged 6¼ days before any come out. As the cars are 6 feet long the length of the oven would necessarily be 6 x 6¼ x 12.8, or 480 feet long. Therefore, a single tunnel kiln would require a building considerably more than 480 feet long. A more convenient arrangement is said to be the use of two double type kilns as illustrated in Fig. 3.

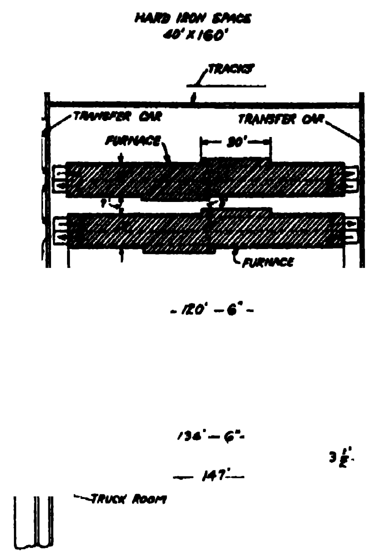


FIG. 3 LAYOUT OF ANNEALING ROOM FOR A MALLEABLE PLANT

In the case under consideration, the two furnaces are placed across one end of the building, adjoining the hard-iron room, leaving ample space for transfer tracks and, with all accessories, occupying not more than 40 feet of the length of the building. Each furnace with its air lock is 134 feet long. The depressed tracks, with transfer cars at each end of the furnaces provide convenient means for handling the cars from the hard-iron room to the kiln, and from the kiln to the dumping floor. Ample space is left for cleaning, sorting, storing and shipping. A 10-foot passage is left for access by industrial trucks to and from the hard-iron cleaning room.

Some Reasons Why Coupling Boxes Break

BY M. E. DUGGAN

AN ARTICLE appeared in a recent issue of THE FOUNDRY illustrating and describing a rolling mill coupling of a new design. The writer of the article refers to the troubles experienced in rolling mill work on account of the couplings breaking after being in service only a few days, and then describes how these difficulties were overcome by a series of experiments supplemented by a study of the conditions under which these castings operate. Some of the experiences of the present writer may be appropriate in this respect since they bear out the value of the policy advocated in the article referred to in THE FOUNDRY. A coupling was designed similar to the one shown in THE FOUNDRY with the exception that one more feature that adds to its worth for the purpose for which it is intended was adopted. This is in the shape of an oil groove which insures constant lubrication on the inside of the box.

Experience gained from observation and study in the rolling mill has shown that in the majority of cases it is not defective material in the casting that causes the trouble. In nearly every case where spindles or coupling boxes break shortly after being put in use, the fault can be traced to incorrect design. Where the boxes do not fit snugly there is excessive back-lash and, if for want of lubrication the boxes do not adjust themselves quickly and readily when the mill is reversed, the pads on the ends of the spindles exert a wedging strain on the coupling boxes and break them. The only way to discover the cause of trouble of this kind and devise a remedy is to study the piece of machinery under actual operating conditions.

About 30 years ago the writer was employed in a mill in the East where 30, 60 and 90-foot rails were rolled. The couplings and spindles in use at that time were the same as those used now. They were known as four leaf clover, or four tooth drive, and a large stock was always kept on hand to replace those which broke, a phenomenon which was even more common then than now.

A new coupling box was designed along lines suggested by a close study of operating conditions in the mill. When the pattern was made and delivered to the foundry, the molding and coremaking was closely watched and after the castings were poured and shaken out they were cleaned so the spindle fitted evenly and closely in the coupling box and all sliding or contact surfaces were free from sand and as smooth as it was possible to make them. Before assembling the couplings and spindles in the roll train the contact surfaces were well greased and they were thoroughly greased every morning thereafter. The grease was applied where it was needed and not in the roll-pit, or all over the roll-housings as is sometimes the case in such work.

This test pair of spindles and couplings ran continuously for four months and a half with no further attention than the daily greasing. A second pair was given the same attention and in another mill; they also ran fq months. By the time a third set was installed the novelty had worn off, they were given a scratch brush foundry finish and placed in the mill. They lasted just two weeks. A fourth set was treated with even less care and they lasted just eight hours. The man responsible for cleaning the castings and the greaser were shown the cause of the breakage and after that there was no more trouble experienced from coupling boxes breaking before had given normal service.

Electrical Melting of Alloys---X

Comparisons Between Types as to Economy Should be Based Upon Identical Operating Conditions—Considerations Which Influence a Choice of Furnace Are Outlined

BY H. W. GILLETT

More Information Needed

ELECTRIC furnace melting as applied to the brass casting industry still is too young to assert positively what constitutes the best practice or what unit takes the lead in economy and efficiency. In the accompanying article, the author emphasizes strongly that accurate data are essential to a comparison between furnaces and that all the contributing factors must be parallel. Relatively minute details may swing the scale for or against equipment which is on trial. A case occurred in a western foundry where it was found impossible to pour bronze castings from the furnace tightly closed. Ingots accordingly were made from scrap and remelted in crucibles before successful castings were produced. On advice of the furnace makers, a brick was removed from the door, when it was found possible to pour good castings directly without remelting. The small detail mentioned represented the dividing point between success and failure for the furnace. As the author states, "What is vitally needed now is specific information on the abilities of each type furnace for particular tasks." Electric melting furnaces are on trial. Careful study and an exchange of experiences is vital to the success of the industry. The brass founders of the country should not return a verdict until all the evidence is in.

SOME of the advertising, and even the technical literature of electric brass furnaces includes detailed cost figures to show the relative costs of melting by fuel and by electricity, in which the item of interest and depreciation on the electric furnaces costing from $10,000 to $20,000 each, has been neglected.

For example, take the figures given on a Baily furnace, in the second reference cited, which are reproduced in Table I. At 15 per cent interest, depreciation and obsolescence per year, 1¼ per cent per month, the extra investment of some $7500 more in the electric equipment over the crucible furnaces, or $93.75 per month, at the production in this case of 70 tons per month, amounts to $1.34 per ton, enough to reduce the calculated saving by nearly one-third. If the extra metal loss in crucibles had been only 2½ per cent, the calculated value of the loss would fall $2.40. Had power cost 1.61 cents instead of 1.41 cents per kilowatt hour, it would have cost $1.15 more per ton. By such an alteration of conditions even as bearing only on these two items and the inclusion of interest, the balance would be 39 cents per ton against the electric furnace. Had the furnace been operated another heat per day, the power consumption might have fallen to 500 kilowatt hours per ton on the yellow brass melted, which would again swing the balance for the electric furnace. Or, since the metal loss is not all zinc, but partly copper, one might calculate it to be 1/3 copper at 18 cents and 2/3 zinc at 8 cents, making the value of the lost metal 11 1/3 cents per pound, so that a 4 per cent saving in the electric would be $9.07 and one of 2½ per cent would be $5.67. Another plant might show widely different figures on the coke-fired crucible cost, while still another would use clay lined ladles instead of crucibles for pouring from the electric furnace. That is, slight changes in conditions from plant to plant, in cost of power, metal, crucibles, fuel and labor will often swing the balance back and forth.

In another comparison* of coke-fired, Schwartz oil furnaces and Detroit electrics, apparently on alloys of the red brass type, the labor cost per ton in coke fires is put at 170 per cent of the figure taken in the comparison previously cited, the ladle cost is given as 20 cents against $3.20, power is taken at 1.6 cents instead of 1.4 cents, interest and depreciation are included and lost metal is valued at 18 cents per pound.

This latter comparison is made on the melting of nine different alloys, whose composition is not given, seven different ones being melted in the pit fires; four, including one not given in the coke run, in the Schwartz; and one, not melted in either of the other furnaces, in the electric. The average pouring temperature from the electric was 2280 degrees Fahr. and 2096 degrees Fahr. from the Schwartz. While such records show the cost of melting in each furnace under the conditions which each worked, a comparison of furnaces melting different alloys, heated to different temperatures, is not accurate as to true comparative power and fuel costs and probably decidedly inaccurate as to comparative metal losses. Such tests can be made, if properly taken, to give exact comparative figures on melting costs in any one plant, at any one period, and for any given alloy; but it is asking too much of the laws of chance that they would ever be exactly true for any other plant, other period or other alloy. Relative cost figures are useful, but only for the particular condition upon which they are based. The first essential for a comparison is *accurate* data on the various items of melting cost in the fuel-fired furnaces, and then equally accurate data on various electric furnaces. If a plant can use a large electric furnace 24 hours a day and has moderately cheap power, there usually is so great a lee-way in favor of electric melting that even rough figures will prove it, but as the usable size of electric furnace becomes smaller, the hours operated per day fewer, and the cost of power higher, each case may approach the border line and be highly debatable. The big plant usually has a sure money saver in the right electric furnace for its work, while the little plant had better investigate before it invests. The big plant with a one-ton furnace, costing $12,000 installed,

*Compare Collins, E. F., Electric Furnace for Melting Non-ferrous Metals, Foundry, Vol. 47, 1919, p. 329.

Anon, Electric Melting Shows Economy, Foundry, Vol. 47, 1919, p. 848.

And for criticisms of such cost figures, see Editorial, Electric Furnace Progress, Metal Industry, Vol. 17, 1919, p. 320.

St. John, H. M., Melting Non-ferrous Metals and their Alloys in the Electric Furnace, Chem. and ——, Vol. 22, 1920, p. 149.

*Reardon, W. J., Electric Melting in an Oil Furnace, Metal Industry, Vol. 18, 1920, p. 208.

producing say 250 tons per month on two-shift operation at 300 kilowatt hours per ton and power at 1¼ cents per kilowatt hour might charge off 60 cents per ton interest and depreciation, and its power cost would be $3.75 per ton. A little one, with a 250 pound furnace costing around $4000 installed, producing 20 tons per month on single shift, at 475 kilowatt hours per ton, power at 2¼ cents per kilowatt hour, would have $3.00 per ton interest and depreciation charge and $9.60 per ton power cost. It would cost the small foundry $8.25 per ton more to melt electrically than it would the large one. Yet the little fellow might be melting with fuel almost as cheaply as his larger competitor. The largest sized furnace that can be kept busy, is the most efficient, in a given type.

Another point to remember, is that the power consumption and production figures quoted by a furnace maker are often those obtained under the best operating conditions, or at least under test conditions, rather than under operating handicaps. This is perfectly just, provided it is made clear what the conditions for those figures are, since to do otherwise would be charging the furnace with avoidable inefficiency of operation.

Table I

Melting Cost Per Ton

CRUCIBLES		ELECTRIC	
Coke	$3 80	Power 575 K W. H. per ton at 1 41c	$8.20
Crucibles	4 60	Crucibles for pouring	2 10
Labor	3 20	Preheating crucibles	80
Metal loss over electric (1% Zn at 8c)*	6 40	Labor	1.00
Upkeep	20	Upkeep	.60
	$18 20		$13 60

*Metal loss, coke, 5%; electric, 1%.

A calculated saving of $4 60.

Makers statements as to metal losses on a given alloy usually can be taken at close to par, because with reasonable care in keeping the furnaces tightly closed, and with the exercise of some common sense in fitting the type of furnace to the alloys to be melted, low metal losses will be the rule in all the furnaces. The uncertainty as to the actual metal losses in the fuel-fired furnaces, due to lack of adequate records, often makes it hard to tell just how much metal electric melting does save.

The choice of a furnace of the proper type for the work to be done should be the result of the consideration of the several factors, as follows:

Present melting cost or possible cost in improved fuel-fired furnaces.

Nature of the work.

Alloys to be melted.

Daily tonnage desired.

Hours per day furnace can be operated.

Characteristics of electric power supply.

Cost of power.

Data at hand to show behavior of different furnaces under corresponding conditions.

Special conditions, such as floor space available, possibility of preheating charge, of mechanical charging etc.

There are some cases where one may at once reject the possibility of electric melting in any type of furnace for the present. A jobbing pattern shop that makes its own castings for brass patterns once a month, could not stand the initial investment in an electric furnace, no matter how desirable its use might be on other considerations. Similarly, the small foundry, where work is intermittent, and where brass or bronze is not melted every day, is not likely to be able to use an electric furnace, although the Ajax-Northrup may ultimately be made cheap enough to meet this requirement. Conversely, the larger the production and the more continuous the operation, the greater is the need for electric melting.

There are probably a few cases where such extremely hot metal is required that no hearth type furnace with double pouring, will serve. For these, lift-out crucible furnaces still may be required, unless the bull is taken by the horns and a small electric furnace advanced which may be picked up and brought bodily to the molds, or, and far more likely, the molds are brought to the furnace.

Where some cost factor in fuel-fired melting is vanishingly small, it may happen that electric melting could hardly compete.

Natural Conditions Govern

For example, one firm, situated in a natural gas field, has its own gas well on its own property. It is probable that this firm properly will continue to use gas-fired furnaces. The converse of this, equally rare, already has been noted in the use of an electric furnace for intermittent service by a firm having available large amounts of hydro-electric power at practically no cost so that the expense for furnace is practically negligible. The writer's own experimental work on electric furnaces of various sorts has been done under similar conditions, since Cornell university, which is co-operating with the bureau of mines, has a hydro-electric plant which runs whether the electric furnace is operating or not. Therefore the use of power for the furnace involves no cost whatever outside of depreciation.

A more common case where electric furnaces are not applicable is that in which the only available source of electric power, say the central station of a small town, is already heavily loaded and the demand for more power is not yet great enough to justify expansion of the central station. In such a case it normally is not justifiable for the foundry to install or enlarge its own power plant to produce power for the furnaces, as the total investment and the operating costs of a small power plant are too great. Quite similar is the case where a small central station has so much lighting load that it has little surplus for industrial power, and the prices for such power are prohibitive.

Expanding Service

Now that electric melting has cut the shackles of the wrought brass industry by making it possible to melt in decent sized units instead of the absurdly small units to which the fragility of large crucibles formerly held it, it is reasonable to expect that the brass industry will go at its problem on a larger scale, almost comparable to the steel industry. Instead of casting 200-pound ingots and cropping a pipe from each, why not cast a 1000-pound ingot and saw it up to size, thus avoiding the waste in crop ends? Is it not possible also to build and operate brass rolling mill machinery that will handle billets, slabs, etc., considerably larger than the present sizes? The writer realizes that there are many reasons why this has not been done, but now that one of the main reasons has been removed it would appear that some further advances in labor saving and decreased production costs could be made by handling larger pieces. If the writer's idea on this is correct, a 1-ton or larger furnace may have an advantage over a 600-pound size in later operations than melting. However, by the time this is worked out, the preformance of a 1500 or 2000-pound induction furnace doubtless will be thoroughly known and its special problems solved, so the induction furnace bids fair to maintain its present supremacy in the rolling mill industry.

In the smelting and refining industry, the task of taking foul miscellaneous junk and making it into high grade ingot, or direct into castings, is facilitated by a large furnace. Such plants normal can operate 24 hours a day and

large electric furnace so operated will save metal enough and show a low enough power consumption to beat fuel-fired furnaces.

These plants usually handle a wide variety of alloys and seldom can use the induction furnace unless they are certain of steady work on yellow metal, nor can they normally use a direct arc or stationary indirect arc type, because of the need for melting yellow brass now and then. The moving type indirect arc stands out as the most generally applicable for such service. Since melting is the main operation in such plants it pays to bend every effort toward the reduction of melting costs, and the efficiency of the type mentioned, together with its ability for large production, recommend it. In melting nickel alloys, monel metal for example, which contain no volatile metal and are closely allied to iron and steel, the direct arc furnace has proved its value and is the natural first choice when such alloys alone are melted. True bronze, and possibly pure copper (always with the proviso that we avoid copper poisoning by fumes) are possibilities, for the direct arc type. Where only red brass or bronze are to be handled, with now and then some cupro-nickle or monel on the one hand, and alloys of not over 15 per cent zinc on the other, the stationary indirect arc furnaces deserve consideration. The choice of the indirect arc furnace for cupro-nickel, bronze and the large scale melts of silver, by the mint, was very suitable. The ordinary jobbing shop, changing from one alloy to another in all ranges of zinc content, and normally operating but eight to 10 hours per day, must choose among the versatile furnaces.

If the power conditions prevent the use of a single-phase furnace, the General Electric or Ajax-Northrup would be the choice, as they are the most fully developed polyphase furnaces. Single-phase furnaces are usually admissible, and the jobbing shops are so far using mainly the Detroit and Booth rocking and rotating furnaces, and the Baily granular resistor furnace.

An inattentive or careless operator [illegible]ably can do more damage to the moving furnace than to the Baily. Where close temperature control and thorough mixing is required or desirable, the former type has an advantage. Where the power supply cannot stand a single-phase 300 kilowatt arc load, but can a 100 kilowatt resistor load, the Baily has a type which will answer. Where high production per furnace is called for, the moving type is ahead. Where melting is but a slight part of the total manufacturing cost the Baily simplicity of operation may overbalance its higher power consumption. Where melting is a big factor in the cost, or where power costs are high (say over 1 1/3 cents per kilowatt hour) the greater thermal efficiency and lower power consumption of the moving type notably overbalances the cost of electrodes and the other factors and swings the scale toward the latter.

Another consideration in favor of the more efficient types of furnace, such as the induction, the high-frequency, and the moving furnaces over the less efficient types, is that the former usually require no more B.t.u. as coal to be shipped to the central station than as coke or oil shipped to the foundry and burned direct in a fuel-fired furnace. The war showed that conservation and efficiency are not merely abstract problems for the next generation, and heatless days, coal strikes, railroad strikes, embargoes, etc., have shown that the more we curtail our requirements for coal production and transportation, the better. Electric brass furnaces effect conservation by saving metal, and by releasing fuel oil for other commercial needs, for shipping and agricultural use.

It is significant that one steel foundry which formerly used a Heroult steel furnace, the standard furnace for its purpose, sold it and replaced it by an open-hearth when the cost of power rose to nearly 2 cents per kilowatt hour.* While the electric furnace gave a higher quality of product, the open-hearth gives a satisfactory quality at a lower cost in this particular case, the cost of power being the deciding factor in the total cost.

Electric melting still is too young for all the needed data on all types and sizes

Table II
Metallurgical Fitness of Different Types

TYPE OF ALLOY									TYPE OF FURNACE						
Chromium	Nickel	Copper	Tin	Lead	Zinc	Mercury	Aluminum	Iron	Direct Arc	Stationary Indirect arc	Moving Indirect arc	Granular Resistor	Smothered arc Reflected heat	Induction Vertical Ring	Northrup High Frequency
15	85 67	 28						 5	OK OK	?(1) OK	?(1) OK(1)	?(1) ?(1)	?(1) ?(1)	? ?	OK? OK?
	25 5	75 95							OK (2)	OK	OK	(1)	(1)	?	OK?
		100							?(2)	OK	OK	OK(1)	OK(1)	?	OK?
		90 88	10 10		 2				OK	OK	OK	OK	OK	?(3)	OK?
		80 76 68	10 3 4	10 18 26	 3 2				OK(5)	OK	OK	OK	OK	No(4)	OK?
		85	5	5	5				No(5)	OK	OK	OK	OK	OK	OK?
		74 80 [illegible] 67 61 65 60	4 1 	5 3 1 	17 20 30 30 [illegible] 34 40				No5	No(5)	OK	OK	OK6	OK	OK?
	18				24				No(5)	No(5)	OK(?)	OK(?)	OK(?)	OK(?)	OK(?)
	3 2				15 30		85 68		No(6)	?	OK(?)	OK	OK(?)	?3	OK?
	8						92		?	?	OK	OK	OK	?3	OK?
	10					90			?	OK	OK(?)	OK(?)	OK(?)	?3	OK
	10				85		5		No(5)	No(5)	?	OK	?	?	OK?

O K = Furnace Metallurgically satisfactory for this alloy
? = No data
OK(?) = Probably satisfactory, but no data
No = Furnace is not satisfactory for this alloy
(1) = Temperatures probably rather high for good life of refractories ordinarily used
(2) = Question of copper poisoning by vapor from direct arc furnace not yet solved
(3) = Induction furnace for this alloy should have a resistor tube of special design—regular design for yellow brass probably not suitable.
(4) = Load too high for good life of lining now used in induction furnace
(5) = Furnace causes loss of volatile metal in this alloy

*Editorial article—Melting changes bring lower costs, Foundry, Vol. 48, 1920, p 253.

of furnaces under all conditions to be available. Much information should be forthcoming in the next few years, particularly from those plants which have installed two or more types of electric brass furnaces. It is unfortunate that only small amounts of what little comparative data on performance of two types, makes or sizes of electric brass furnace on the same work have been secured by such plants, are as yet available. Most of the plants which have gone deeply enough into the problem to see the advisability of installing different types for different work do not care to handicap production by running tests of each type on the various classes of work, and what data they have to show that one furnace is more or less desirable for certain work than another is often withheld because the user sees that each type is valuable and he does not like to throw cold water on its use, even though, under his own conditions, another type will do better work. However, what is vitally needed now is specific information on the abilities of each type for particular tasks, and, even more vitally, data on the limitations of each type. For example, there is no available data on nickel brass (German silver).

It is believed that enough has been said in the preceding articles of the series and in this, to show that electric brass furnaces as a class are an epochal improvement in nonferrous technology, and to make it equally clear that there is no such thing as any one *best* electric brass furnace. Every type, and nearly every form and size of each type, has its specific virtues and limitations which fit it for some work and make it less fit for other work.

The proper choice of an electric brass furnace concerns the user, the furnace maker, and the central station. The first is concerned only with his own problem. The second has a reputation to make or to maintain which is more important than an individual sale. The third should take the broadest point of view of all the interested parties, since if electric brass melting is advanced by fitting the furnace to the job rather than by crowding every foundry foot into the same sized furnace shoe, this field, a most attractive one to the central station, will widen more rapidly. The prospective user has a right to expect that the central station can give him unbiased information. The wise central station manager will inform himself fully and impartially in order to be able to give such advice.

The foundryman should get all the help he can from central station men and from furnace salesmen, but he should let neither attempt to influence him toward a particular type, make or size of furnace on merely general grounds. Each foundry is a particular case and demands its own comparative cost sheets with each item backed up by facts. The furnace salesman usually can prove what the power consumption and metal loss will be for his electric furnace. It is equally necessary that the foundryman know, and not guess, the fuel consumption and metal loss in the fuel-fired furnaces with which he is comparing it.

How and Why in Brass Founding

By Charles Vickers

Adding Deoxidizers in Melting Brass

We have three brass mixtures to make, regarding which we would like to obtain information with especial reference to the order in which the white metals should be added, whether before or after the deoxidizers. The alloys follow: Copper, 85 parts; tin, 5 parts; 5 per cent phosphor tin, 5 parts; lead, 5 parts. Copper, 73.5 parts; 15 per cent phosphor copper, 7 parts; tin, 12 parts; lead, 7.5 parts. Copper, 85.5 parts; 30 per cent manganese copper, 5 parts; tin, 11 parts.

The best time to add the deoxidizing alloys is after the copper is thoroughly molten and quite hot, and before the other metals. In this manner it does its work of purification much better than otherwise. Add the phosphor tin or the phosphor copper to the alloy first, alloy a couple of minutes for the process of deoxidation, then make the other additions.

Manganese copper is used in the same manner as phosphor copper as far as the time of addition goes. It is more important, though, that it be added before the white metals. The use of this deoxidizer is limited to about 0.5 per cent. More than this amount brings on casting difficulties, as the alloy rolls, instead of running into the mold. As it rolls it folds in a brown, tenacious skin of oxide which ruins the castings. Five parts of manganese copper is too much, and it will be necessary to add a small percentage of aluminum to run the metal. If 0.5 per cent manganese copper is intended, this amount can be added and a good casting metal will result. The alloy with 7 per cent phosphor copper is a difficult casting alloy and large castings should be made in baked molds coated with plumbago wash.

Brass for Pressure Bearing

We would like to obtain a mixture suitable for bearings and brasses subjected to considerable pressure as well as severe jolting which breaks many kinds of alloys. Also, would the same metal be satisfactory for slides subjected to pressure?

The following alloy is suggested: Copper, 88 per cent; tin, 8 per cent; lead, 4 per cent. About 0.25 per cent of phosphor copper may be added as a deoxidizer. For the slides add 10 per cent tin, instead of 8 per cent, and reduce the copper 2 per cent.

Overcomes Shrinkage by Change of Gating

We are making some small funnel-shaped castings and experience considerable trouble from defects in the heavier part of the castings. These defects cannot be detected until the castings are machined, as they are underneath the skin. The metal is a good grade of yellow brass, but similar defects also appear in red brass castings. The defects do not appear to be due to porosity as they exist as isolated cavities which, in the yellow brass, resemble worm holes in wood, but, in the red brass, exist as specks. We enclose samples of castings for your inspection.

The defects are due to shrinkage. In the absence of any definite knowledge, we will assume the castings are molded with the large or funnel end towards the cope; that the funnel cavity is partly formed by a cone-shaped green-sand core carried in the cope, as that would be the easiest way to make them. The funnel part is massive and remains liquid after the stem has largely solidified. The stem is then fed by the funnel which acts as a riser to insure solidity of the stem, at the

pense of the funnel. The usual method of gating such castings in brass foundries, is to place a small, rectangular runner in the drag, between two rows of the castings, and to connect the latter to the runner by small gates. Under such circumstances, after filling the mold, the runner and gates solidify first unless close to the sprue. Then the castings must feed themselves. In the rough they may appear good, but if much machine work has to be done on them, shrinkage cavities are uncovered, and the loss runs high. This appears to fit the present case. The remedy is to place another runner on top of the one in the drag. Use a loose wooden runner and lift it in the cope. Make it ⅞ inches high, ¾ inches wide at the bottom, and ⅛ inches wide at the top, thus having plenty of taper. If this runner fails to entirely stop the trouble, enlarge the gates also.

Seeking Trouble Sources in Brass Castings

We have had trouble lately from pin holes in the brass castings we are making, and would like your advice. These pin holes show up after the casting is machined, and we have tried everything we can think of to overcome the difficulty. We are using the best ingot copper with Straits tin and pure lead in these mixtures, and in melting keep the crucibles well coked, and the metal covered with charcoal and glass. In addition we have tried new sand for the molds, and new annealed crucibles for melting.

We also operate an iron foundry, but we guard carefully against iron contamination of the brass, as we use a different sand for the bronze and separate equipment such as riddles, etc. The cupola is approximately 50 feet from the brass furnaces, and the brass grinding room is separate from the iron grinding room. As a flux for the brass we use rock salt. We shall appreciate any suggestions you may offer.

In this case it appears that everything is being done that skill can suggest to avoid the appearance of the pin holes, but as the pin holes are in evidence it will be obvious there is a break in the defense somewhere. This break must be found, and as it is a most important matter, we suggest that one of the workers be relieved of all other duties. and given the job of discovering the cause of these pin holes. It must be kept in mind that there is nothing mysterious about the matter; something is wrong somewhere, and it should be the business of the one appointed to find out just what it is. We will offer a few suggestions to guide him as follows: Every operation connected with the making of these castings must be analyzed, never mind if it has been done before or not, have it done again, and have the results checked over. Begin with the metal weighing; follow every stage of the melting, and keep a written record of the work. It will be strange if, under these circumstances, a solution of the difficulty is not soon found.

It will be well to know the cause of such pin holes; the most fruitful cause is aeration of the metal while it is melting, and this aeration can occur even though the metal is well covered with charcoal and glass. Charcoal and glass protect the metal, only when it is fluid, but after it reaches a red heat the metal can absorb both oxygen and sulphur, the two elements that cause the holes. Therefore, the metal should be protected before it is melted, as well as after. It is a great help if deepeners are used on top of the crucibles; a deepener is an old crucible with the bottom chopped off with a hatchet. Set the deepener on top of the pot after it is coked up. Put no coke around the deepener. Use it as a hopper to contain the ingots or gates that might stick up above the top of the crucible, if the latter was charged without a deepener. Put one or two small blocks of hard wood in with the ingots as the gases given off by the wood help to protect the copper. When burnt, the blocks form charcoal. A little salt also assists. Try and get all the charge into the crucible and deepener when cold, then melt without having to add cold metal to that already liquid. If gates form part of the charge, put the brass in first, copper on top. The brass will then melt and form a bath in the bottom of the crucible, and this liquid metal will bite off the bottoms of the copper ingots, and cause them to come down more quickly. The solid metal must be aided in sinking down in the crucible, it must never be allowed to wilt down of its own accord. To this end, it should be poked down at intervals, because once it is melted it is completely covered from the furnace gases by the floating charcoal and the other flux substances used. After it is melted it should be thoroughly stirred. Then the tin, zinc and lead added, and stirred and heated until ready to pour into the molds. The addition of a little deoxidizer will do no harm. Add 1½ ounces of phosphor copper to each 100 pounds of metal. Place the phosphor copper in the bottom of the crucible and melt the metal on top of it. See that all these precautions are actually carried out. The only way in which a chemist can assist is in making analyses of the coke for sulphur. The trouble may be due to using a high sulphur coke. This will do no harm if the sulphur can be kept out of the metal, but once there it finds oxygen with which to combine and thus makes the gas sulphur dioxide, which aerates the metal. Again, the sulphur may burn in the furnace to sulphur dioxide, and the copper will absorb this gas if it can come into contact with it, and thus produce porous castings. Of course, there are other causes of porous castings. Thus wet or hard rammed sand will cause porosity, and the holes will be found usually in the cope side. Hot sand also will cause porosity; molds must not be made with a backing of hot sand as it will steam through into the mold cavity. If the molds are skin-dried use no coremaking binders of any kind as a spray to harden the surface of the mold. Even molasses, containing sulphur dioxide, is doubtful. We believe that attention to the suggestions we have made will uncover the cause of the difficulty with pin holes in the case of these castings.

Casting Steering Wheels of Aluminum

We desire information regarding what is known as No. 12 aluminum. This alloy consists of copper 8 per cent and aluminum 92 per cent, and we would like to learn if there is a better alloy available for making aluminum steering wheel centers for automobiles. We experience considerable trouble on account of this alloy's tendency to shrink where heavy spots occur in the castings. We have overcome this by using chills, but as these require time for setting, we have wondered if some other mixture could not be substituted that would not require these chills.

The No. 12 aluminum is the best mixture to use for these spiders, provided it is sufficiently strong for the purpose. It is doubtful if any alloy could be substituted to avoid the use of chills to control shrinkage. The only relief there is from the use of chills is to employ risers, but these are more trouble than the chills. In connection with the casting of aluminum there is one point founders are likely to overlook. Aluminum is approximately one third the weight of brass and, therefore, it is necessary to raise the height of the pouring head over what would be satisfactory in the case of brass, otherwise, the required pressure is not put on the casting, and shrinks and other troubles are encountered. The pouring head for aluminum should be approximately three times that used for brass and if this rule was followed more generally, there would be fewer losses from shrinkage and other difficulties.

Self-Propelled Trucks Reduce Costs

Ease of Operation and Adaptability of This Type of Vehicle Makes It Particularly Well Suited for Use In and Around a Foundry for Intraplant Haulage—Numerous Uses Suggested

BY R. J. WEAN

THE installation of laboratory and other auxiliary equipment to reduce melting losses and to cut production costs has been steadily gaining favor among foundry executives in recent years. However, there is one factor, the cost of labor and the transportation of materials which has a direct bearing on the total cost of the manufactured product which is not recieving the wide spread recognition which its importance seems to warrant. With the exception of the more modern continuous foundries, wheel barrows and cumbersome hand trucks still are employed to convey material around the foundry and from one department to another.

Under present industrial conditions, high cost of labor and extremely high labor turnover, foundry executives will find it worth their while to make a serious study of material handling and transportation problems. The development of industrial transportation equipment has been comparatively recent and only a relatively small number of industrial executives have had opportunity to study its application to their particular problems. The size of a plant and the existing conditions will determine the type of equipment most appropriate.

Many applications will suggest themselves to the ingenious owner of a self propelled truck and a general outline of some of the more obvious uses to which it is adapted follows:

Handling raw materials; Sand, coke limestone, pig iron and scrap.
Materials in progress; Cores, coremakers and molders daily supplies, flasks, to and from storage, patterns, to and from storage and molten metal.
Finished product; Castings from floor to cleaning department, from cleaning department to shipping room and from shipping room to cars.
Reclaimed material; Gates, scrap and defective castings.
Waste material; Cupola drop to dump, burnt sand and sand blast refuse to dump.

Operated at Low Cost

The cost of handling sand stored in an overhead bin and loaded in a V-dump body erected on a storage battery truck as shown in the illustration Fig. 1, is surprisingly low. Even if the sand is loaded by hand upon the same style truck a material labor saving over the usual wheelbarrow method may be effected. The usual capacity of one of these trucks is 1½ yards of sand, or approximately 15 wheelbarrow loads.

Foundries in which the amount of sand handled is not sufficient to keep a unit of this kind busy could find employment for a lift truck with V-dump skids. After the truck delivers sand it can be used elsewhere either as a flat burden bearing truck or in conjunction with skid platforms.

Pig iron and scrap are loaded into box skids by magnet or other means and transported by lift truck to the cupola charging platform where the material can be charged mechanically if necessary. Aside from the labor saving feature, this system of loading and transporting the cupola charge eliminates to a great extent the hazard to hands and feet when the same work is done by manual labor.

Coke and limestone are handled in the same way as pig iron with the

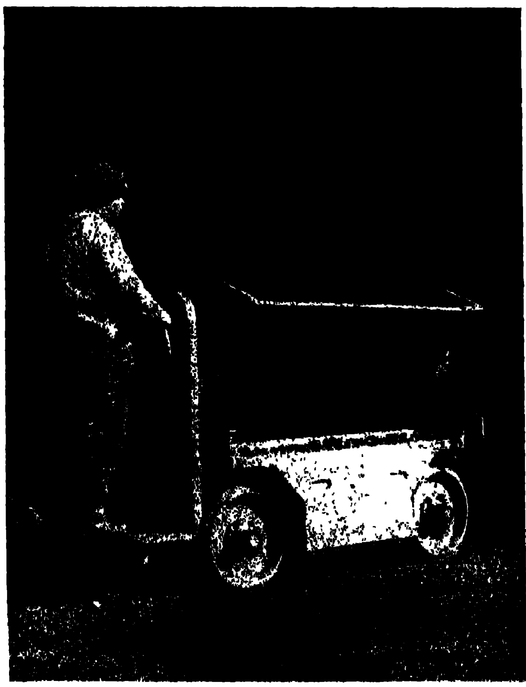


FIG. 1—DUMP TRUCKS ARE EASY TO LOAD FROM AN OVERHEAD BIN. FIG. 2—THE LIFT TRUCK CAN BE OPERATED IN NARROW AISLES AND AROUND CORNERS QUITE READILY AND ELEVATES ITS LOAD TO A HEIGHT OF SEVERAL FEET

exception that larger boxes are necessary. The trucks are built to carry a certain weight and it is advisable to load them to capacity.

Lift trucks may be used to advantage in the core room. The work benches can be arranged to better advantage because the distance from the oven makes no material difference. Racks for loading the cores may be left at any convenient point and when loaded they can be picked up by the truck and conveyed into the oven. After the cores are dried they are taken out of the oven by the same truck and either carried to the stock room or taken directly into the foundry for the molder's use. It never should be necessary for the molders or coremakers to go to the store room for supplies. Arrangements easily may be made for delivering all store room supplies by truck. This will eliminate wasted time and extra labor.

Increases Yard Space

The interior of a foundry should not be used as a storage place for flasks and bottom board. Capital invested in a foundry is intended for the purpose of producing a marketable commodity. The percentage of return on the investment is in proportion to the percentage of capacity employed for productive work. When flasks are carried to and from the yard or storage entirely by hand or by wheelbarrow the labor cost is very high. With a lift truck these flasks and boards may be handled on skids and piled as high as desired with a corresponding reduction in the labor cost and an increase in the available yard space. This idea may be carried still further. Skid loads may be tiered so that any part of the pile can be withdrawn without disturbing the loads on other shelves and brought into the foundry without any rehandling. This, of course, would only apply where they would be required at frequent intervals, otherwise a large supply of skids would be tied up.

Patterns may be handled in the same manner as flasks. Instead of allowing a large number of patterns to accumulate in the foundry, a regular schedule can be made whereby a truck that has been engaged in other work all day can make one or more trips between the pattern storage and foundry the last thing in the afternoon.

With reasonably good floors and aisles trucks are steadily coming into favor for carrying hot metal from the cupola to the different floors.

(*Concluded on page* 582)

FIG. 3 THE TRACTOR SPOTS THE TRAILER WITH AN EMPTY DUMP BODY AT THE CUPOLA

FIG. 4 - AFTER THE TRAILER IS LOADED THE TRACTOR RETURNS AND HAULS IT TO THE DUMP

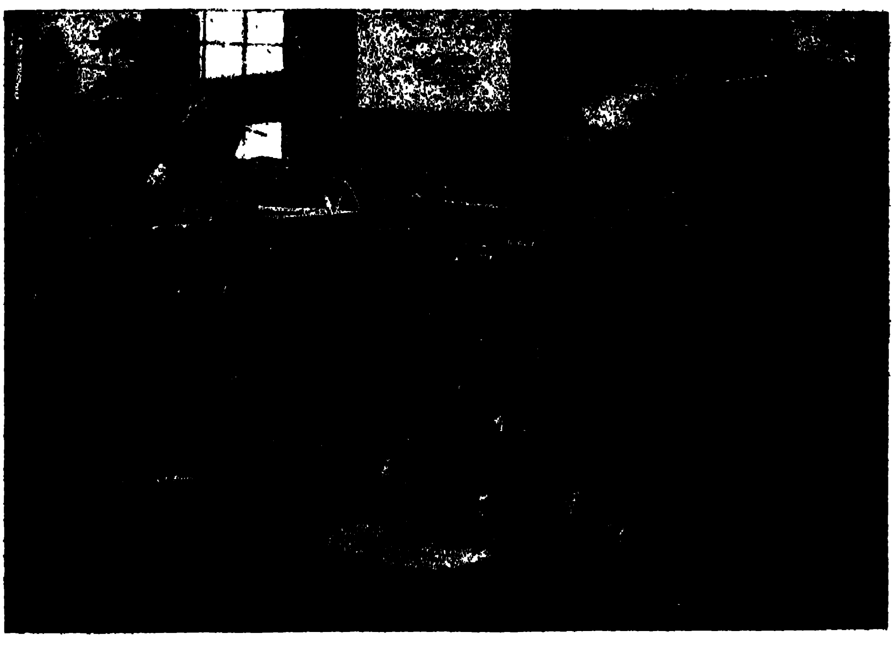


FIG. 5—STORAGE BATTERY TRUCKS ARE EMPLOYED FOR CARRYING THE METAL FROM CUPOLAS

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Contents

Coke Must Be Conserved

ACCORDING to the best informed opinion, there will be a serious shortage of foundry coke within a few months. Shortage of cars, priority orders, railroad strikes, and other causes have thrown production so far behind that the coke ovens of the United States will be approximately 25 per cent behind in 1920. The cost of coke is increased each time it is handled, that is loaded or unloaded. For this reason and also because of lack of storage space, the coke companies, so far as possible, load directly from the ovens to railroad cars.

When cars are scarce as they are at present, makers are tempted to allow their ovens to lie idle until a supply of cars seems reasonably assured, or if cars are available, to draw the ovens before the coking process is finished. In either case the foundryman suffers. He receives no coke or he is compelled to accept 20 to 40-hour coke instead of the standard 72-hour product. The most irritating feature from a foundryman's point of view, lies in the fact that he actually needs the coke to take care of increased business and furthermore, although he has the money and is ready to pay a price for which he could have purchased pig iron a few years ago, he cannot get deliveries on his coke orders. In fact, in a great many cases he cannot even *place* his coke orders and must remain constantly on the alert to pick up scattered lots here and there.

There is only one way in which each foundryman may do his part to relieve the situation and incidentally curtail his operating expenses. He can reduce the amount of coke which he has been using. Under ordinary circumstances it might not be necessary to urge conservation, as the added expense of higher price fuel would act as a brake upon extravagance, but when the situation becomes national in character and there are prospects that indicate a 25 per cent reduction in castings output due to lack of fuel, the situation is serious enough to demand earnest and concerted efforts to conserve.

Foundrymen Need Broad Training

ONE of the great needs of the foundry industry is thoroughly trained men. Many large companies have taken the initiative in establishing practical schools where men who are qualified may receive training in the theory and application of foundry principles. Many companies that educate their men in a broad comprehensive manner undoubtedly lose some of them after they become experts. However, such firms secure enough benefits during the time these men remain amply to pay for the troubles taken in training them. The technical features of foundry practice are not so complicated that the workmen cannot hope to attain them. On the contrary, a basic understanding of the general principles involved in molding, coremaking and in mixing and melting iron, readily may be assimilated by the better class of foundry workers, especially the young men who understand the English language. Were technical training offered to every employe at his own volition it would amply pay for the effort. At present there is entirely too great a distinction in many foundries between the so-called practical man and the metallurgist or engineer who is considered in a different class from the man who has worked up from the molder's bench.

Trade Outlook in the Foundry Industry

COKE is the key-log in a jam which threatens to close foundries throughout the east and central west unless relieved within a short time. With only a portion of normal coal shipments reaching the ovens, and with labor shortage and a dearth of cars to transport the product, coke is becoming increasingly difficult to obtain. The stringency in this case is not limited to any one locality nor district, but seems to have fastened a firm grip on all the great producing sources simultaneously. Some foundries have closed while an emergency supply is being sought to tide over operations pending some more lasting relief.

Effect Far Reaching

Those large coke producers which supply blast furnace interests, of course, are favoring their associated companies. One southern by-product plant has served notice upon its foundry customers that it cannot supply any further coke upon contracts during the remainder of the year, unless a radical reverse is encountered and coal can be obtained freely. In explanation, this maker states that with only about 50 per cent of its coal requirements coming to the ovens, the entire output will be required to keep the blast furnaces of its related companies in operation. Iron production also is threatened and a number of furnaces are proceeding on slack blast while some have been banked within the past week. In a few localities where reserve stocks of coke have been exhausted, foundries have closed with no assurance that they may be able to resume soon. Those which are so fortunate as to have several weeks supply in their yards are working on part time schedule and husbanding every resource. Some instances are reported where pea-coke, often mixed with broken debris from the oven linings, and yard scrapings is being sold for $5 or more per ton to foundries which are using this fuel in their mold and core ovens to conserve the foundry coke for their cupolas.

Car Order Pinches

The drastic ruling of the interstate commerce commission limiting open top cars solely to coal transportation has had a far reaching effect. While distinction has been made in some instances which allows coke to be transported, still the spirit of the order has been prejudicial to many transportation needs. Railroads in some cases are accused of stretching a point to serve their own interests in hauling coal, and no reserve which would assure cars when needed at the ovens has been possible. Blast furnaces dependent upon open top cars through their use of loading equipment limited to this class of rolling stock, have been severely handicapped. This factor coupled with the coke shortage have put a number out of blast. Cars of all descriptions to transport northern iron have been lacking, but the southern furnaces have been slightly more fortunate. The latter also have been better able to adapt closed cars to their needs, and foundries have been receiving southern iron recently in box cars, cattle cars, and even refrigerator cars. Transportation difficulties have reacted upon prices both of pig iron and coke for immediate delivery and many plants even though they have these materials contracted have paid premium prices for spot delivery. A tendency has been noted, particularly among larger foundries to contract as far ahead as possible, even in advance of probable needs. A few have purchased iron far ahead of their last half requirements, in the hope of securing delivery upon a portion of this for a reserve against early 1921 needs. In St. Louis, although the nominal price for Connellsville coke has been around $18 ovens, sales have been reported on small lots as high as $25. Despite the discouraging factors encountered during June, pig iron production showed a slight gain. With a total of 3,044,351 tons, June registered an increase of 52,526 tons over May as shown by figures compiled by *The Iron Trade Review*. The June output averaged 101,478 tons per day or an improvement of 4968 tons over the May daily average of 96,510 tons. However, the increase was confined to steel works furnaces, as the merchant stacks lost 880 tons per day during June as compared with May. The daily average for June was 25,209 tons as compared with the May average of 26,089 tons for merchant stacks.

Orders Continue

Orders for castings still continue, although many foundries report a slackening off in volume of new business. The automobile and implement trades are strong factors in the castings market, while cast iron pipe, fittings and miscellaneous castings for construction purposes are less actively sought. Early and favorable action is expected on the recommendation of the association formed by railway executives to hasten the grant of a loan of $183,691,508 from the revolving fund of the transportation act for the purchase of new cars and locomotives and for rebuilding and repairing equipment. Within the last week or 10 days private interests and railway companies have placed orders for over 3000 steel cars in the Pittsburgh district, while refrigerator, stock and open top cars have been placed in large numbers in Chicago and vicinity. This buying shortly will bring new business to malleable and steel foundries. Prices of nonferrous metals, based on New York quotations follow: Copper, 18.25c to 18.37½c; lead, 8.50c; tin, 48.50c to 48.75c; antimony, 7.50c to 7.75c; aluminum, No. 12 alloy, producers' price, 32c and open market, 30c to 31c. Zinc is quoted at 7.75c to 7.80c, St. Louis.

Prices of Raw Materials for Foundry Use

CORRECTED TO JULY 8

Iron	
No. 2 Foundry, Valley	$15 20 to 46.20
No. 2 Southern, Birmingham	40.00 to 42.00
No. 2 Foundry, Chicago	44.00 to 45.00
No. 2 Foundry, Philadelphia	46.85 to 49.35
Basic, Valley	45.00
Malleable, Chicago	43.50
Malleable, Buffalo	46.25
Coke	
Connellsville foundry coke	17 50 to 18.50
Wise county foundry coke	17.00 to 18.00

Scrap	
Heavy melting steel, Valley	$25.00 to 26.00
Heavy melting steel, Pittsburgh	25.50 to 26.00
Heavy melting steel, Chicago	23.00 to 23.50
Stove plate, Chicago	31.50 to 32.00
No 1 cast, Chicago	41,00 to 41.50
No. 1 cast, Philadelphia	37.00 to 39.00
No. 1 cast, Birmingham	30.00 to 33.00
Car wheels, iron, Pittsburgh	38.00 to 39 00
Car wheels, iron, Chicago	35.50 to 36.00
Railroad malleable, Chicago	28.75 to 29.25
Agricultural malleable, Chicago	28.50 to 29.00

Comings and Goings of Foundrymen

DR. GEORGE S. WEBSTER the newly elected president of the American Society for Testing Materials is a Philadelphian. Graduating, in 1875, from the civil engineering school of the University of Pennsylvania located at that city, he became affiliated with the engineering service of Philadelphia and has been connected with the engineering work of that city ever since. Dr. Webster served as chief engineer of the city from 1892 to Jan. 1, 1916, when he was appointed director of wharves, docks and ferries. This position he held until this year when he was reappointed chief engineer. Besides his regular work he also had charge of the bureau of filtration for one year, and for a while was acting transit commissioner for the city. In all these positions Dr. Webster has been in close touch with the testing of materials. One of his achievements in this line was the establishment of a municipal testing laboratory. This laboratory was first used only for cement testing but its scope has been gradually increased until now all materials and supplies used by the city are tested by the laboratory force. Interested in the development of his profession he has been active in a number of societies and is past president of the Philadelphia Engineers club; the Philadelphia association of the American Society of Civil Engineers; and of the Sanitary Engineering section of the American Public Health association. Dr. Webster is at present one of the three representatives of the American Society of Civil Engineers on the engineering division of the National Research council. His alma mater conferred on him the degree of Doctor of Science in 1910.

R. W. Scott has been made superintendent of the foundry division, Packard Motor Car Co., Detroit.

S. B. Spalding recently has resigned his position as general manager of the Lansing Foundry Co., Lansing, Mich.

C. C. Peterson has been made foundry manager for the R. Herschel Mfg. Co., Peoria, Ill., which has constructed a large new addition including a gray iron and a malleable foundry.

Harold P. Furlong recently has acquired the interest of Leonard D'Ooge in the partnership of D'Ooge and Furlong Foundry Supplies and Equipment, Detroit. Mr. Furlong has secured a new warehouse which is located at 26 Richmond avenue, Detroit, where he will continue to handle foundry supplies of every character.

Lee W. Van Cleave, of the Buck's Stove & Range Co., St. Louis, was re-elected president of the National Association of Stove Manufacturers at its recent annual convention. Other officers re elected are. First vice president, Robert M. Leach, Weir Stove Co., Taunton, Mass.; second vice president, B. E. M. McCarthy,

DR. GEORGE S. WEBSTER

Phillips & Buttorff Mfg. Co., Nashville, Tenn.; treasurer, Walter M. Jones, Richmond Stove Co., Richmond, Va.; and secretary, R. S. Wood, 508 National State Bank building, New York City.

Charles Gaspar, formerly of the Detroit office, has been made assistant manager of sales of the National Malleable Castings Co., at Cleveland. At one time Mr. Gaspar was in charge of the company's St. Louis office. L. W. DeWitt, formerly of the Chicago sales force, and recently transferred to Washington, succeeds Mr. Gaspar at Detroit, in looking after miscellaneous sales in the Michigan territory. George V. Martin goes to Washington to succeed Mr. DeWitt. Elmer Juergens, purchasing agent at Cleveland for the National company, recently was chosen president of the Cleveland Purchasing Agents' association.

C. F. Drozeski, D. A. Drozeski, and F. T. Kennedy recently have purchased the Franklin Park Foundry Co., Franklin Park, Ill. This plant which is located in a suburb of Chicago includes a malleable foundry with two 12-ton air furnaces having a capacity of approximately 450 tons per month. Connected with this is a gray iron foundry which has an average output of 300 tons per month. The new company which will be known as the Central Malleable Castings Co., expects to start operations about Aug. 1.

Invite Industries to Safety Council

The National Safety council has launched a membership campaign with a two-fold ultimate aim—first, to introduce organized accident prevention work in every plant of more than 100 workmen in all of the industries rated as hazardous by insurance companies and second, to bring to the 7500 plants that are already members of the council the benefit of the accident experience, both good and bad, of every industrial plant in the country having a serious hazard.

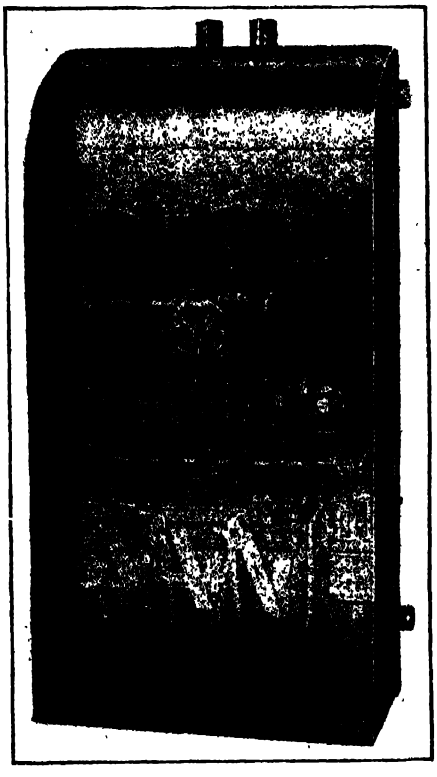
As the first step in this campaign the story of what the council is and what it does together with copies of the *National Safety News* and of the council's bulletin service have been sent to 16,000 plants, including practically every company rated at more than $100,000 in the 15 most hazardous industries not already members of the council. These 15 groups include cement manufacturers, chemical manufacturers, coal mines, construction and building contractors, electric light and gas companies, electric railways, foundries, glass manufacturers, iron and steel mills, large gas companies, meat packers, metal goods manufacturers, paper and pulp manufacturers.

Craig Adair, formerly vice president of Penn Seaboard Steel Corp. and Paul Day of the same corporation, have resigned and have formed the Adair-Day Corp. to handle iron and steel products and mechanical specialties, with offices at 1025 Widener building, Philadelphia.

Automatic Starter for Induction Motors

An automatic starter suitable for use with squirrel cage induction motors when they are driving line shafts, pumps, compressors and similar devices, has been developed by the General Electric Co., Schenectady, N. Y. It may be operated by push button, float switch, pressure governor or other automatic accessory.

When in use the master switch is closed. This closes the 5-pole starting contactor which connects the compensator coils to the line, also the primary leads to taps on the coils, thus reducing the starting voltage.



AUTOMATIC ENCLOSED STARTING MECHANISM FOR MOTORS

The accelerating relay also is connected to the line circuit and operates at the pre-determined current value for which it is set. It opens the circuit to the starting contactor coil and closes the circuit of the 3-pole running contactor coil. This circuit is held closed by a shunt coil.

An interlock on the starting contactor completes the circuit to the line contactor coil when the former opens, thus preventing the closing of the starting contactor before the running contactor has opened. The starting contactor is further provided with a normally open interlock which makes it unnecessary to hold the starting button or other device in during the starting period.

The contactors are provided with magnetic blowouts, moisture proof coils and solid copper contact tips that are easily renewable. Equipment in steel mills, cranes and other heavy duty apparatus that requires continual starting, stopping and reversing of heavily loaded motors has proved that this type will stand up well under severe service.

The compensator winding has two coils for 2-phase motors and three for 3-phase which insures balanced starting currents and maximum starting torque per ampere line current. The taps terminate in an accessible place in front of the compensator coils. The set most suitable for any particular application may readily be selected.

The motor is automatically started by means of this device independent of the operator's judgment. This is accomplished through the accelerating relays or current limit relays which operate the contactors to disconnect the auto-transformer and connect the motor on the line on proper acceleration. Overload protection is furnished by two inverse time element relays which are operative during both starting and running. After an overload they may be reset by means of handles which project through the panel behind.

Make Special Delivery

The Farrell Foundry & Machine Co., Ansonia, Conn., recently, telephoned to the New York office of the Lakewood Engineering Co., Cleveland, requesting the quickest possible delivery of a tractor. It was impossible to await delivery from the factory, so a machine which with its batteries weighed almost two tons, was taken from the show room, loaded upon a dray by means of an elevating platform truck made by the Lakewood company and delivered to a cartage company. Here it was reloaded upon a motor transport truck and taken overland, being delivered and ready for service within 30 hours after the order was placed.

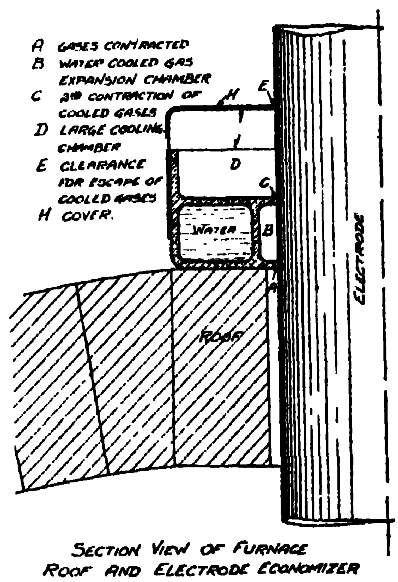
Prepare Motion Pictures

A series of motion pictures has been prepared showing the Sullivan Machinery Co.'s plants in Claremont, N. H., and in Chicago. Interior views of the Claremont foundry show the pouring of air compressor castings. Various processes of manufacture through the stages of machining, assembly and erection are given. Other portions of the film depict manufacture of different mining machinery and the use of this machinery in mines. The films were taken by the Rothacker Film Mfg. Co., Chicago.

Device Cools Gas Around Furnace Electrodes

A device designed to cool the gases below the ignition temperature as they come from the electric furnace through the holes around the electrodes has been developed by the Electric Furnace Construction Co., Philadelphia. When the gases pass out through the economizer, cooled below the ignition temperature, no flame is started and the electrode is not burned as it would be by a flame of ignited gas playing around it.

As shown in the accompanying illustration, the device consists of water cooled rings which fit around the electrode directly above the furnace roof. While the gases are inside the furnace, they are under reducing conditions,



DETAILS OF ECONOMIZER FOR COOLING GASES FROM ELECTRIC FURNACE

and have, therefore, only their own sensible heat and no heat generated by the oxidation of combustible constituents. These gases first pass in between the electrode and the port hole of the roof, and then through a clearance in the cooling ring and into a relatively larger chamber, which causes the expansion of the gases, thereby giving up a large amount of sensible heat in the gases. This heat is absorbed by the water in the cooling ring. From this chamber they pass through a small clearance, and then enter a very large chamber for a second and much larger expansion. This chamber is surrounded, in the case of graphite electrodes, by a thin enclosed cover, which, in actual practice, has been found quite sufficient to dissipate the heat given up by these gases, and when they finally pass through the temperature is below ignition.

It is stated that on 3 and 6-ton furnaces using graphite electrodes, the

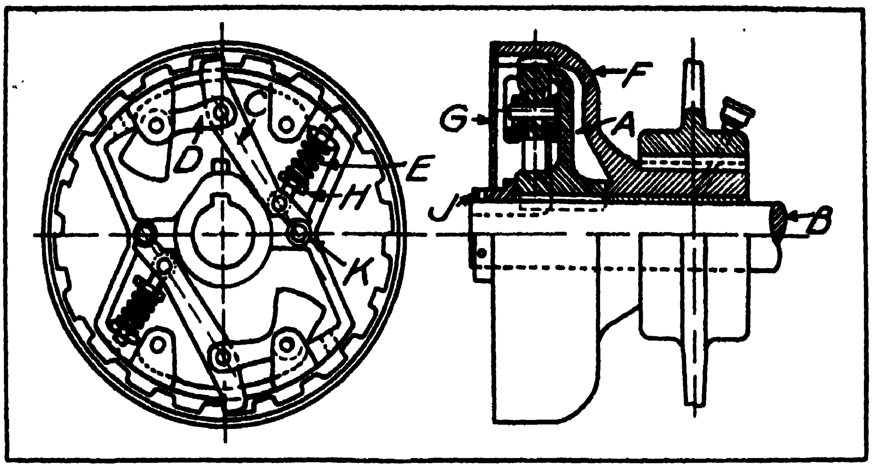


FIG. 1—DIAGRAM OF WORKING PARTS OF AUTOMATIC OVERLOAD RELEASE

electrode consumption has been reduced from an average of 30 pounds to from 10 to 15 pounds per ton on steel by means of the economizer.

Automatically Releases Driving Mechanism

The mechanical device shown in the accompanying illustrations has been developed by the Link-Belt Co., Chicago, to provide a pronounced factor of safety in the operation of elevating, conveying and power transmission machinery. It is designed to disengage the drive instantly when the load exceeds a predetermined point.

The spider *A*, keyed to the shaft *B*, has triggers *C* pivotally mounted on the links *D*, with the ends engaging inside notches in the rim of the drum *F*, and rollers *K*. The springs *E* regulated to any desired pressure by the adjusting

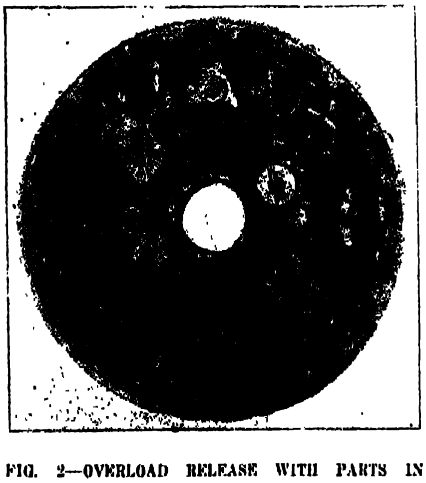


FIG. 2—OVERLOAD RELEASE WITH PARTS IN POSITION FOR DRIVING

nuts *H* hold the ends of the triggers on the rollers *K* under normal conditions. When the drive is over stressed the compression of the springs will permit the ends of the triggers to drop into the position shown in Fig. 2, releasing connection with the rim *F* and allowing the driven machine to stop immediately.

The construction of the device is such that it will release whether the load is gradually or suddenly applied, but it can be set so that it will not trip from a jar or shock. It is symmetrical and can be assembled to operate in either direction. It can be adjusted for tension and

FIG. 3 OVERLOAD RELEASE WITH PARTS IN RELEASED POSITION

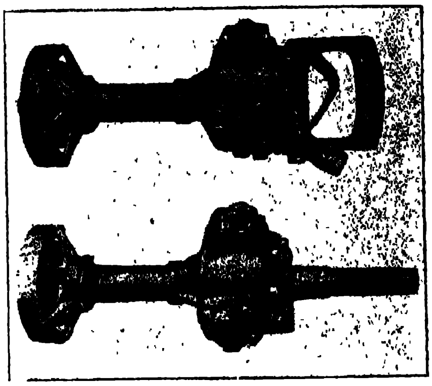
set to operate at any desired over load. The mechanism is entirely enclosed and can be packed with grease for lubricating the working parts.

The McLain-Carter Furnace Co., Goldsmith building, Milwaukee, recently received an order for the installation of a second open-hearth furnace in the plant of the Aetna Steel Casting Co., Lorain, O. This company has been operating a 5-ton furnace of the McLain-Carter type and has made numerous record heats, having melted 5 tons in two hours and 15 minutes.

The Cleveland Co-Operative Stove Co., Cleveland, recently has completed a plant addition which includes an assembly, japanning and pattern shops.

Small Pneumatic Grinders

Small pneumatic grinders recently designed by the Ingersoll-Rand Co., New York, and shown in the accompanying illustration, are light weight, high speed tools running with a free speed of 4200 revolutions per minute. They are suitable for grinding, buffing and polishing various kinds of work. Both of the machines shown



SMALL GRINDERS ARE OPERATED BY SELF-OILING MOTORS

are provided with the same style of motor but are equipped with different types of throttles and handles.

A special feature of these tools is the 3-cylinder motor which constantly runs in a bath of oil, insuring lubrication of all the parts. Lack of proper oiling has been one of the reasons for grinder trouble in the past. The valve is made integral with the crankshaft, simplifying the design. The piston and connecting rods also are uniquely constructed. Ball and roller bearings are used throughout. The removal of a few screws permits the handle to be lifted off and exposes the entire interior mechanism to view for inspection.

Self-Propelled Trucks Reduce Costs

(*Concluded from page 577*)

Ladles of from ½ to 1½ tons capacity are erected on skids provided with rollers so that if necessary they can be pushed by hand. The lift truck may be employed to pick up both skid frame and ladle and carry it to any designated point. The metal is distributed in hand ladles.

After the molds have been dumped the castings can be loaded in metal boxes or on iron bodied trailers. Where the volume of work warrants, a number of trailers will prove economical. Much more material can be moved in a given time because the tractor can pull from five to ten times the tonnage a lift truck could carry in one load.

Castings should be routed from

the casting floor to the car in which they are shipped in as straight a line with as few rehandlings as possible. Lift trucks and skids meet these conditions admirably. By keeping the castings on skids or on trucks they are readily accessible for grinding or for any other operation and can be conveyed to the shipping department when finished. If a lift truck is used, the skid loads may be piled selectively.

The Material Handling Machinery Manufacturers association recently has changed its headquarters from 35 W. 39th street, to 110 W. 40th street, New York. Zenas W. Carter is secretary and manager.

Plan Enlarged Plant

It is stated that present production will be trebled when a series of improvements and additions to their plant at Kenton, O., will have been completed by the Champion Engineering Co., builders of electric traveling cranes at that place. The foundry will be extended and new buildings erected for structural steel fabricating shops; raw material storage; a tool and jig manufacturing plant; a pattern vault and steel foundry. Besides these, a new power plant of sufficient capacity to take care of future power requirements will be built. The present power plant will be retained for emergencies.

The company has inaugurated a building program which includes 50 houses to be constructed immediately, to be followed by others as circumstances warrant. These houses are to be built on a plot in the center of the company's grounds and will be sold to the men on the payment plan. A company hotel which will also serve as a civic center will be built on the same property and will form the main gathering place for employes.

The hotel will at first accommodate 50 people and will be provided with an auditorium 30 x 100 feet, suitable for business meetings, lectures, picture shows and banquets. The basement will be fitted up as a club room with baths, gymnasium, billiard and pool tables and bowling alleys.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

M. D. Drake has purchased the plant of the Hub City Pattern Works, Centralia, Wash.

The plant of the Union Foundry, Rockford, Ill., recently was damaged by fire.

The Landian Foundry Co., South Haven, Mich., recently purchased a site for a plant.

The plant of the Bennington Foundry Co., Dallas City, Iowa, recently was damaged by fire.

The plant of the Keystone Brass Foundry Co., Pittsburgh, recently was slightly damaged by fire.

Erection of an addition to its plant, to house a foundry and machine shop, is being planned by the Johnson Bronze Co., New Castle, Pa.

Contracts have been awarded by the Onley Foundry Co., Philadelphia, for the erection of an addition to its plant.

B. F. Avery & Sons, Louisville, Ky., have been granted a permit to go ahead with the construction of an addition to their foundry building.

The Louisville Aluminum & Brass Foundry, Louisville, Ky., recently was incorporated by William O. Bonnie Jr., Elmore Sherman and E. E. Kirwan.

Capitalized at $5000, the Ann Arbor Foundry Co., Ann Arbor, Mich., recently was incorporated by Thomas Kooks and others.

The South Haven Foundry & Machine Co., South Haven, Mich., recently increased its capital stock from $25,000 to $50,000.

The Ervin Foundry & Mfg. Co., Adrian, Mich., contemplates the erection of additions to its plant.

Work has been started on the erection of a machine shop and foundry for the Delaware Aluminum Co., Muncie, Ind.

The Interstate Brass Mfg. Co., 11 South Desplaines street, Chicago, plans the erection of a one and two-story plant, 73 x 125 feet.

The Des Moines Foundry & Machine Co., 314 Flynn building, Des Moines, Iowa, is building a foundry and machine shop, 180 x 220 feet.

Plans have been prepared by the National Brake & Electric Co., Milwaukee, for the erection of an addition to its foundry, 166 x 180 feet.

The Portland Foundry Co., Portland, Me., recently was organized with a capital stock of $250,000.

Contracts have been awarded by the Herschel Mfg. Co., Peoria, Ill., for the erection of an addition to its foundry.

The plant of the Central Brass Mfg. Co., 6207 Cedar avenue, Cleveland, recently was damaged by fire.

A O'Neill, 68 Post street, San Francisco, has plans for the erection of a plant to be equipped as a brass works.

The plant of the John Watson Mfg. Co., Ayr, Ont., manufacturer of agricultural implements, etc., recently was damaged by fire.

The Farrel Foundry & Machine Co., Ansonia, Conn., recently took over the plant of the Seymour Mfg. Co.

Plans have been drawn for J. A. & W. Jolly Co., Holyoke, Mass., for the erection of a new foundry building.

The Brown & Sharpe Mfg. Co., Providence, R. I., expects to have its new foundry in operation some time in August. With new equipment the daily cupola capacity will total more than 100 tons.

The Equipment Mfg. Co.'s new foundry which has been under construction at Conneaut, O., for some time, has been completed and has been placed in operation.

The Atlas Foundry Co., Lyons avenue and Colt street, Irvington, N. J., has had plans prepared for the erection of an addition to its plant, 50 x 75 feet.

Capitalized at $1,000,000, the American Malleable Iron Co. recently was incorporated in Delaware by John Dearree, Clarence A. Southerland and W. G. Singer all of Wilmington.

The Waukesha Malleable Iron Co., Waukesha, Wis., has been leased to the General Motors Corp., according to a recent announcement by A. Haertel, president.

The Northern Brass Foundry, Portland, Oreg., has been organized by W. C. Thom, Robert J. Gray and others, and plans to establish a foundry and repair plant.

Henry Holder Jr., architect, 242 Franklin avenue, Brooklyn, N. Y., is preparing plans for the erection of a foundry, 100 x 250 feet. The name of the owner has been withheld.

The Roos Foundry, Inc., Chicago, recently organized with $500,000 capital, has taken over the plant of the Henry Roos Foundry Co. and plans the erection of additions to the plant.

The W. Robertson Machine & Foundry Co., 58 Reno street, Buffalo, has had plans prepared for the erection of an addition to its plant, 120 x 170 feet.

The Haywood Foundry Co., Indianapolis, recently was incorporated with a capital stock of $15,000, by M. E. Haywood, A. H. Cromley and Harris Farris.

Capitalized at $100,000, the McFadden Foundry & Machine Co., Columbiana, O., recently was incorporated by W. A. Lyder, M. L. McFadden, E. W. Forney, C. Frederick, W. C. McCord and A. F. Poulton.

H. E. Powell, Fannie H. Powell and J. A. Mullins were named as the incorporators of the Sweetwater Machine & Foundry Co., Sweetwater, Tex., which was recently chartered with a capital stock of $10,000.

The Dominion Brass Products, Ltd., Toronto, Ont., has been incorporated to manufacture brass, etc., with a capital stock of $40,000, by Thomas B. Richardson, room 41, 2 Wellington street east, Edward A. H. Martin, 44 Elgin avenue, and others.

The Kelley Foundry & Machine Co., Elkins, W. Va., recently was incorporated with a capital stock of $25,000, by Samuel T. Speers, C. H. Hall, S. H. Watring, D. J. Blackwood, J. F. Kelley and J. P. Kelley.

Capitalized at $3,000,000, the Reading Steel Casting Co., New York, recently was incorporated with an active capital stock of $3,000,000, by W. B. Lasherm, W. J. T. Moore and W. T. Morris, 540 Crown avenue, Brooklyn, N. Y.

The Copper Products, Ltd., Montreal, Que., recently was incorporated to manufacture copper, brass, etc., with a capital stock of $3,000,000, by Gordon W. MacDougall, William B. Scott, James A. Mathewson and others.

A recent increase in the capitalization of the Cleveland Co-Operative Stove Co., Cleveland, was made to cover the cost of new buildings and equipment at its plant. The company now has a foundry, 135 x 1000 feet.

A foundry will be built at Columbiana, O., by a company which is being formed by Clyde Hoover, William Shaufer and F. H. Grove. The building will be 100 x 120 feet, and castings for rubber machinery will be the product.

Data, catalogs and information regarding modern foundry equipment are desired by the Owego Foundry & Machine Co., Owego, N. Y. It plans the erection of a frame plant addition, 36 x 78 feet, so

that it can be extended readily to 78 x 108 feet. Pierre Duvinage is proprietor of the company.

To provide additional working capital, the Western Foundry & Mfg. Co., Springfield, O., recently increased its capital stock from $10,000 to $30,000. At present no plant enlargements or equipment purchases are contemplated. Clarence O. Lutz is secretary of the company.

The Kokomo Malleable Iron Co., Kokomo, Ind., has been organized with a capital stock of $350,000 and plans are being prepared for the erection of a malleable plant, the main building to be 85 x 360 feet. The equipment will consist of two 15-ton furnaces with a daily capacity of 30 tons.

The General Motors Corp. has purchased the Doylestown Agricultural Works, Doylestown, Pa. It expects to erect there within two years a large plant for the manufacture of automobiles and farm machinery. The General Motors Corp. will continue the manufacture of farm machinery for export at the present plant.

Increasing its capital stock from $100,000 to $300,000, the American Metal Products Co., Milwaukee, has purchased a 6½-acre site on which it plans to erect a modern foundry, 80 x 220 feet, immediately and later erect a rolling mill for the rolling of rods, strips, sheets, etc.

The Service Casting Co. recently was organized at Blanchester, O., to specialize in the manufacture of small gray iron castings. The foundry has been in operation since last February, doing contract work. Officer of the company include, R. B. Huyett and Charles N. Serrist.

Because of the needs of its greatly increased business, the Lansing Foundry Co., Lansing, Mich., recently increased its capital from $150,000 to $350,000. This will enable it to carry larger stocks of raw materials and to accumulate the products it manufactures. Glen L. Orr is secretary and general manager of the company.

Work has started on the erection of the new plant units for the Gilbert & Barker Mfg. Co. Springfield, Mass., which will consist of a 3 story, 63 x 222-foot recreation building: a sheet metal building addition, 164 x 181 feet, a foundry, 80 x 400 feet and various other structures. Actual construction of the buildings has been held up by the scarcity of materials and labor troubles.

The Valley City Machine Works, Grand Rapids, Mich., has increased its capital from $50,000 to $250,000. This increase will be utilized for the purpose of developing a new plant on the site purchased when the company's gray iron foundry was established two years ago. This improvement, however, will not be made for some time. An announcement will be made later regarding necessary equipment, etc.

When its new building is completed the American Machine & Foundry Co., 5520 Second avenue, Brooklyn, N. Y., will employ 2500 workmen. The new 5-story structure will be 100 x 190 feet with a 30 x 50-foot annex. The general contract for the building has been let to the H. D. Best Co., New York. Equipment will consist of cranes, industrial railway, sprinklers, compressed air, monorail system, etc.

The Cuyahoga Foundry Co., Cleveland, which was organized recently was a capital of $200,000, to manufacture gray iron and semisteel castings, is planning to engage in active business shortly. The company has a plant, 109 x 180 feet, equipped with a 10-ton and a 3-ton traveling crane. Officers of the company are: President, John Vild; vice president, Anton Anyz; treasurer, Charles Wachalee and secretary, Frank J. Opatrny.

Work has been started by the Dominion Steel Products, Ltd., Brantford, Ont., on the erection of a new pattern shop, to take care of the increased demand brought about by the recent completion of its gray iron and brass foundry. The foundry is equipped with a 20-ton air furnace used for the manufacture of chilled and cast iron rolls, close grained iron castings, etc. It also has two cupolas with a capacity of 12 tons per hour and an electric brass furnace of 1000 pounds capacity.

The Westport Brass Foundry, Inc., Westport, Conn., recently was organized with a capital stock of $25,000, of which $10,000 has been paid in. The company is building a small plant in order to get into production immediately, hence equipment requirements are small. Later on the company will build a large structure. The building now in course of erection is on the Boston Post road, Westport. Officers of the company are: President, W. A. Seide; treasurer, K. Klein, 1862 Second avenue, New York, and secretary and manager, C. Craig, 179 Wilson street, Bridgeport, Conn.

Assets of the Standard Steel Castings Co., Cleveland and Chicago, have been acquired and its liabilities assumed by the Interstate Foundry Co., Cleveland. This will permit of the expansion and development of the Standard company's business and the consolidation has been ratified by the stock holders of both companies. The Interstate company now is engaged in settling accounts of the Standard organization and F. B. Whitlock, vice president and general manager of the company, has this matter in hand. A complete announcement as to the plans of the company is expected to be issued shortly.

Formed to take over the business recently carried on as a partnership by the Springfield Aluminum Plate & Castings Co., Springfield, O., a company with the same name has been incorporated. While the product heretofore has been confined to a large extent to the making of vibrator pattern plates and aluminum pattern castings, the new organization contemplates production of large work. On July 1 the company moved into new and larger quarters. Officers of the company are: President and general manager, P. A. Parker; secretary and treasurer, W. J. Jordan, and vice president, I. K. Hook. These men with H. S. Simondinger and W. Ream compose the board of directors.

With headquarters at 204 Medford building, Akron, O., the National Furnace & Stove Co. has been organized with a capital stock of $350,000, and plans the erection of a plant at Ravenna, O. The plant will consist of a foundry, 82 x 121 feet, with a capacity of 50 complete furnace casting daily; tin shop and office building, 82 x 100 feet, and other structures. Because of the scarcity of homes the company also plans to erect houses for its employes. Officers of the company are: President and general manager, George Heinecke; vice president, C. C. Earnest; secretary-treasurer, H. H. Montis; general sales manager, V. W. Jaeger, and general superintendent, R. W. Mizner. Work on the erection of the plant is expected to be started about Sept. 1.

New Trade Publications

FLEXIBLE HOSE.—Flexible steel hose for industrial work is described in a small booklet recently published by the Sprague Electric Works of the General Electric Co., New York.

RECORDING DEVICE.—The Gisholt Machine Co., Madison, Wis., is circulating a 4-page leaflet in which various points of a recording machine for use in keeping accurate tab of the amount of time on work being performed, are pointed out.

GRINDING WHEELS.—The use of grinding wheels on the Blanchard surface grinding machine is described and illustrated in a 22-page booklet being circulated by the Norton Co., Worcester, Mass. Some interesting data are given.

GRAPHIC INSTRUMENTS.—The Esterline Co., Indianapolis, is circulating a 4-page leaflet entitled, "Graphic Instruments in the Field of Transportation," in which the use of recording instruments on steam and electric railroads is described. A number of charts are given.

ELECTRIC DRILLS AND GRINDERS.—Portable electric drills and grinders, including drills for operation on both alternating and direct current, are described and illustrated in three leaflets issued under one cover by the Standard Electric Tool Co., Cincinnati.

STEEL HOSE.—The Sprague Electric Works of the General Electric Co., New York, has published a 20-page illustrated booklet in which it describes and illustrates flexible steel hose for use in railroad service. Specifications and other data are given.

OXY-ACETYLENE APPARATUS.—Acetylene generators, welding and cutting torches, pressure regulators and portable welding and cutting outfits are described and illustrated in a 16-page booklet, recently published by the Davis-Bournonville Co., Jersey City, N. J.

GAS PRODUCER.—The Wellman-Seaver-Morgan Co., Cleveland, has prepared a 48-page booklet in which its mechanical gas producer is described and illustrated. The booklet contains a number of interesting chapters, including one on operation. Data given includes gas analysis, installation, tables, etc.

HEAVY EQUIPMENT.—The Wellman-Seaver-Morgan Co., Cleveland, has published a series of booklets in which various heavy equipment which it manufactures is described and illustrated. The equipment includes: Hoisting and mining machinery; hydraulic turbines; steel works equipment; coke oven machinery; port and terminal equipment; special cranes, rubber machinery and coal and ore handling machinery. The illustrations show the various equipment at work and line drawings accompany each halftone illustration.

TRUING DIAMONDS.—The Norton Co., Worcester, Mass., has published an illustrated booklet in which commercial diamonds for truing grinding wheels are described. Origin, classification, color, quality, shapes and sizes of the stones and other details are given, including the method of setting and suggestions for their use, etc.

POWER TRANSMISSION.—The Fairbanks Co., New York, has published a cloth-bound book in which various equipment handled by the company's power transmission division, is described and illustrated in a clear and concise way. Tables and specifications, which act as an aid to purchasers in determining their requirements, are given, as well as suggestions for installing the various equipment.

OIL CIRCUIT BREAKERS.—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a number of leaflets in which oil circuit breakers are described and illustrated. Both application and distinctive features of the various breakers are discussed. Each leaflet contains a table, giving an outline of maximum current, voltage and interrupting capacity ratings. Some of the circuit breakers described handle voltages as high as 25,000 and are rated as high as 23,000 amperes. They are for indoor service, either manually or electrically operated, with full automatic, nonstop, single throw control.

INDUSTRIAL LIGHTING.—The Cooper Hewitt Electric Co., Hoboken, N. J., is circulating a booklet containing a number of illustrations showing industrial lighting installations. The installations include those at the plant of the American Radiator Co., Bayonne, N. J., showing illumination in the naval gun shop; the shell plant of the E. W. Bliss Co., Brooklyn, N. Y.; the ordnance section of Dodge Bros., Detroit; the machine section of the Champion Spark Plug Co., Toledo, O.; the erecting aisle at the plant of the Liberty Machine Tool Co., Hamilton, O.; the main aisle of the plant of the Cincinnati Planer Co., Cincinnati; the screw making machine department of the Pheoll Mfg. Co., Chicago; the tool room of the Cincinnati Milling Machine Co.; the engine testing room of the Willys-Overland Co., Toledo, O.; the assembling department of the Avery Co., Milwaukee, and a number of others including those at motor plants and textile mills.

THE FOUNDRY

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How Glass Factory Molds Are Made

The Peculiar and Severe Treatment to which These Molds Are Subjected Makes Their Successful Production a Metallurgical Rather Than a Purely Mechanical Problem

BY PAT DWYER

GLASS is one of the best known and universally used substances of the present day and yet the methods of its production and manufacture are practically unknown except to the people directly engaged in the industry. The same is true of many manufactured articles which make our modern civilization possible; but while many of these things are the result of modern processes and inventions and therefore in the natural order of things, are more or less of a mystery; the manufacture of glass for ornament and use dates back to the days when the ancient Egyptian and Babylonian civilizations were flourishing. According to Pliny the discovery of glass was accidental. A party, having built a fire of sea weed on a sandy beach, was surprised on raking over the ashes in the morning to find a fused, solid and semitransparent lump of material. Articles made of glass were familiar to the ancient Greeks and Romans and specimens found in the ruins of Pompeii and Herculaneum bear mute evidence that the inhabitants of those unfortunate cities were acquainted with its manufacture and use. The beautiful and artistic creations in glass for which it was famous helped to spread the reputation of Venice and the immense, artistic and beautiful stained glass windows placed in some of the great European cathedrals in the middle ages still remain as monuments to the patience, art and skill of the master craftsmen who flourished in those times.

The mixture of materials and the methods of melting glass have undergone practically no change in recent years, but the manipulation of the molten glass into various commercial shapes has been highly developed. Mechanical methods largely have superseded early processes where success depended altogether on the skill and training of the operator's hand and eye. A great deal of artistic glass still is made by highly skilled mechanics or more properly speaking,

FIG. 1—THE PATTERN ON THE RIGHT AND HALF MOLD CASTING ON THE LEFT FOR MAKING THE GLOBE SHOWN IN THE CENTER

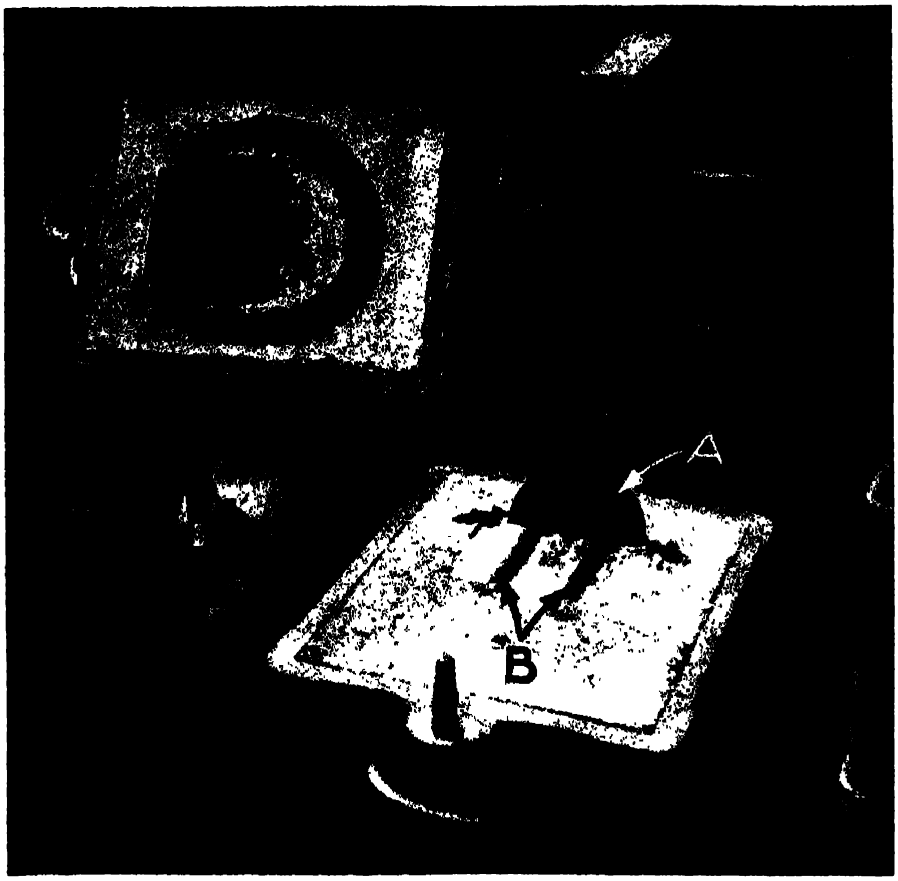


FIG. 2—MOLDS ARE CAST FACE DOWN WITH THE BODY OF THE CASTING IN THE COPE. THE MOLD SHOWN IS FOR A DOUBLE BOTTLE MOLD

artists; but the great bulk of manufactured glass is made by machinery. This is true particularly of America and the countries supplied with American machinery where the pressed glass industry has been brought to a high state of perfection.

An idea of the volume and scope of the glass industry in the United States may be gained from a recent bulletin issued by the United States geological survey in which it is stated that 2,172,887 short tons of glass sand, having a value of $4,209,728 were produced in this country in 1918. The resources of the United States in sand suitable for making the more common kinds of glass are great. Twenty states produced glass sand in 1918 and deposits occur in other states in numerous localities. However, the great bulk of the sand used in the glass industry in the United States, or approximately 93 per cent, is produced in six states which in the order of production are: Illinois, Pennsylvania, West Virginia, Missouri, New Jersey and Ohio. Pennsylvania, West Virginia and Ohio, in the order named, have the largest number of glass factories because they have cheap and abundant natural gas for fuel. The producers of glass sand in Illinois and Missouri must sell their product at a low initial price to compete with producers in the states just named.

Cast iron plays an insignificant part in the furnaces and appliances used for melting the glass, but in the manipulation of the material after it has been melted the various tools, machines and molds made of cast iron may safely be credited with the present tremendous volume of the glass industry. The furnaces in which glass is melted are built of firebrick in the shape of a vertical stack comparatively large at the bottom and tapering sharply and steadily toward the top. A number of openings are provided in the wall at a convenient height from the floor and each one of these openings communicates on the inside with a similar opening in the side of a fireclay pot in which the molten glass is contained.

From a foundry standpoint, the pots are charged in practically the same manner as crucibles for melting metal and the analogy holds good throughout, for after the charge has melted, it all is withdrawn before a fresh charge is added. About 75 per cent of each charge is made up of new material consisting of sand and small quantities of other ingredients which are added to produce different qualities and forms of glass. The other 25 per cent is made up of broken glass which corresponds to the scrap, sprues and runners in a foundry. The number of pots in a furnace varies and depends, like the size of a cupola in a foundry, on the volume of business done by that particular factory. The pots are never allowed to cool but run continuously until worn out.

A considerable quantity of glass still is gathered by hand and blown into shape either with or without the use of molds, but the great bulk of glass made today, whether blown or pressed, is formed in cast-iron molds. When glass is blown, the air from the workman's lungs or compressed air is used to form the core or inside shape of the article, while the cast iron mold simply forms the outside surface. In making pressed glass articles, the mold is in two parts and forms both the inside and outside of the object. The upper part of the mold acts as a plunger determining the thickness of the glass walls and forcing the glass into all the impressions in the outside wall of the mold. Since it is essential that the plunger can be removed after it has performed its function it follows that only


FIG. 3—TYPICAL WOODEN PATTERNS FOR MAKING SINGLE AND DOUBLE BOTTLE MOLDS, ALSO CHILLS FOR THE SAME AND WOODEN PATTERNS FOR MAKING THE CHILLS

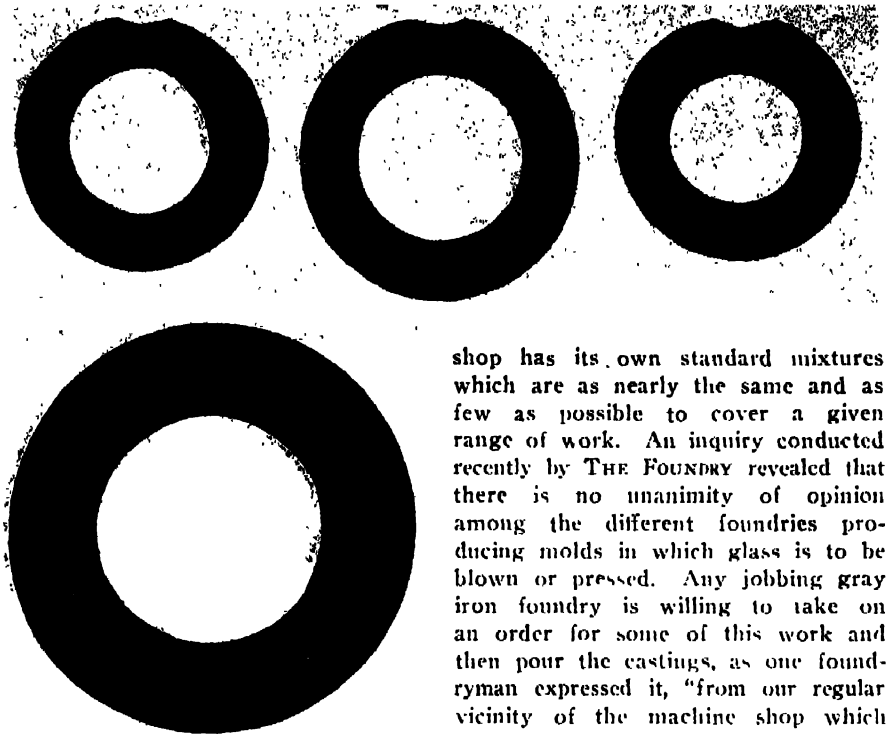


FIG 4 PLASTER OF PARIS IS USED EXTENSIVELY FOR MAKING GLASS FACTORY MOLDS—IT CAN BE MANIPULATED EASILY

certain shapes can be made by this process. As in foundry work ingenious mechanical devices are employed to produce complicated shapes which at a casual glance would be deemed impossible of production on a press.

The flat, iron plates on which hand wrought glass, plate and window glass are manipulated require no special comment other than that they must be planed absolutely flat and accurate, but the molds in which glass is blown or pressed call for the highest type of skill and patience on the part of the machinist who finishes them. All the larger glass factories maintain their own mold finishing shops and in addition to these many shops in the principal glassmaking centers are devoted to this class of work exclusively. Their work is by no means confined to the shops in their immediate vicinity but as in the case of some of the famous American machines for which the molds are intended, their orders come from every country in the world where glassmaking machinery is used.

The creative spirit which brought some of these almost human machines into existence and the high degree of skill necessary to finish the molds seem to have stopped at the door of the machine shop. At present there are no foundries devoted especially to the production of glass house molds. Such castings generally are made in some jobbing shop in the It is well known that every jobbing shop has its own standard mixtures which are as nearly the same and as few as possible to cover a given range of work. An inquiry conducted recently by THE FOUNDRY revealed that there is no unanimity of opinion among the different foundries producing molds in which glass is to be blown or pressed. Any jobbing gray iron foundry is willing to take on an order for some of this work and then pour the castings, as one foundryman expressed it, "from our regular vicinity of the machine shop which has the order for supplying molds. mixture." This regular mixture varied from a metal having a silicon content of 2.50 per cent in a light machinery shop to one running less than 1 per cent in a plow shop, which would produce widely differing metals.

Many different materials have been tried in the manufacture of glass factory molds, but none of them equals cast iron. The ideal mold must be hard enough to take a high polish and to resist the constant scouring necessary to keep it in good working condition; and still be soft enough to permit the machinist to tool and finish the face at a reasonable cost. The same condition prevails to a certain extent in the manufacture of molds for rubber tires and the same measures practically are observed to attain the desired results. The face of the mold in both cases is poured against a chill and in some cases where the amount of glass factory work on the floor seemed to warrant, special charges have been made up to pour it. At least one foundry claims to get superior molds from a semisteel mixture while another which

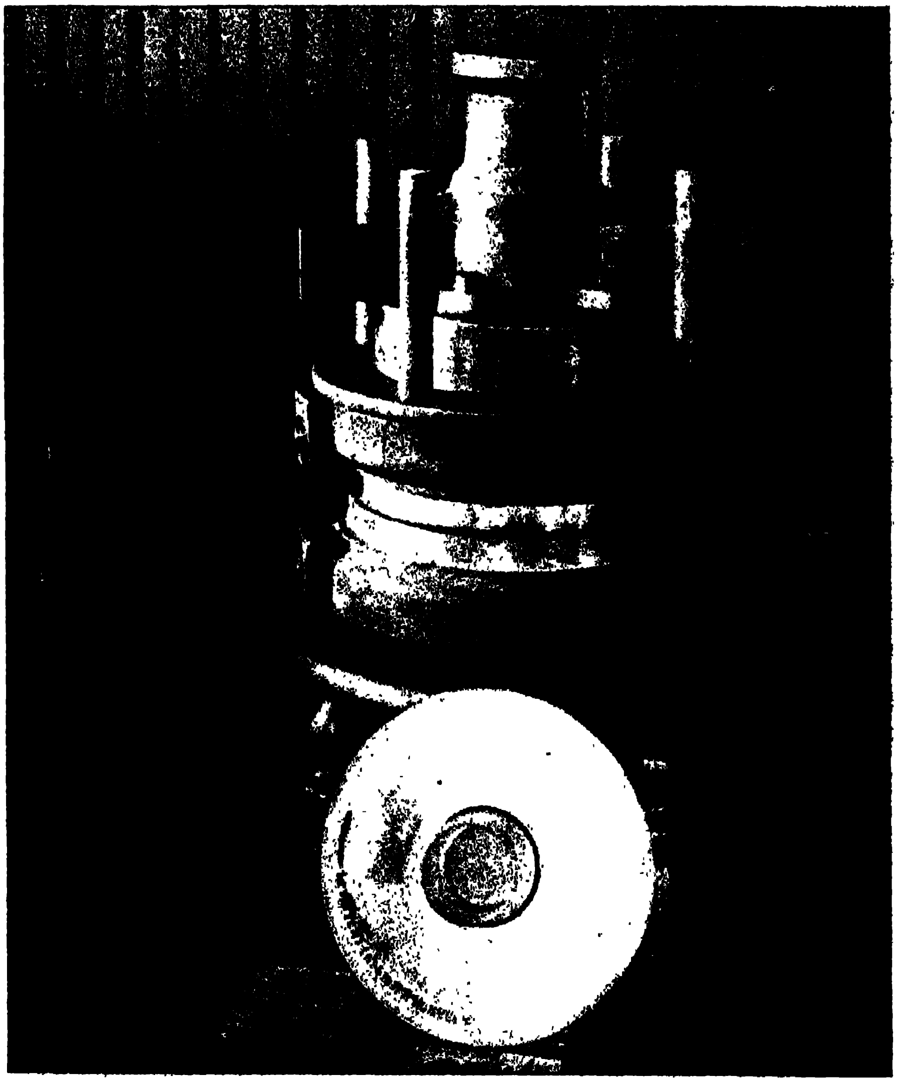


FIG. 5—AN ASSEMBLED MOLD FOR MAKING THE AUTOMOBILE HEADLIGHT WHICH IS SHOWN IN THE FOREGROUND

FIG. 6—BOTTLE MOLDS CHIPPED AND CLEANED READY FOR SHIPMENT TO THE MACHINE SHOP

does a considerable amount of this kind of work uses charcoal pig iron in the mixture.

The superintendent of one glass factory frankly stated that he was disappointed in the quality of most of the molds received. This factory maintains its own finishing shop, but as in the case of other factories places its orders for castings with any shop that is willing to take them. He pointed out that in many cases this is an absolute necessity because frequently they receive orders for glass goods which must be delivered on a certain date or the order forfeited. It then is a case of getting the mold castings in the shortest possible time and the foundry which promises the quickest delivery gets the order. He said that it is not a question of cost either with his company or any other with which he is acquainted, they are perfectly willing to pay a premium to secure satisfactory molds; but so far have been unable to do so.

For various reasons none of the glass manufacturing companies, as yet has seen fit to operate its own foundry, but at the present time one of the largest seriously is contemplating the erection of a small foundry in which to carry on a series of experiments to determine just what is the most satisfactory iron for glass bottle molds. The molds are subjected to many severe tests and it is only natural to suppose that a special iron developed to meet these conditions would be a dividend paying investment.

When in use glass molds are kept as nearly as possible at a uniform temperature of 300 degrees Fahr. If they are used while at a lower temperature *fish scales* or blisters are formed on the surface of the bottle, while if they become much hotter the molten glass adheres to the face of the mold. The molds are swabbed lightly with crude oil at frequent intervals. The frequency of this treatment varies according to the size of the bottle, but in general it may be said that one application of oil is sufficient for the blowing of from 20 to 30 bottles. The oil seems to perform the same function in the iron molds that coal dust does in a sand mold for an iron casting. It makes the face of the mold smooth and shiny.

Constant use of the machine operating these bottle molds soon would cause the molds to become red hot and therefore useless. To obviate such a contingency, an air jet connected to the central air supply is located over the opening in each mold and may be regulated to blow cold air into each mold on its passage between *full* and *empty*.

Some years ago, and even yet in some places where bottles are blown by individual workmen, artificial cooling of the molds was not considered necessary. Each workman was provided with two duplicate molds and by using them alternately he was enabled to maintain the proper temperature. Each workman gathered his own glass and blew the bottle. His helper attended to opening and closing the hinged molds. These old time bottle blowers worked at a remarkably swift pace but have been nearly all displaced in recent years by one of two types of American bottle blowing machines which practically have revolutionized the bottle blowing industry. It is conservatively estimated that each machine does the work of nine men, besides doing it better, cheaper and more uniformly. The machines are automatic and perform every operation in the formation of a bottle from sucking up the glass from the pot to depositing the finished bottle on a conveyer belt which carries it into the *lehr* or oven where it is annealed. The capacity of the machine depends on the shape and size of the particular bottle on which it is operating but for an illustration it may be said that it is capable of turning out 5000 quart milk bottles in a 9-hour day. On the large size bottles the molds are single but the molds for small bottles are double, that is, each unit contains two molds and therefore the output of the machine is doubled while working at the same speed. Triple molds are under consideration at the present time.

Typical patterns together with the

FIG. 7—ON THIS PARTICULAR JOB TWO MEN WORKING PIECE WORK MAKE 80 MOLDS A DAY

FIG. 8—COVERING FRAME FOR A MOLD IN WHICH GLASS CASKETS ARE PRESSED

chills used for making bottle molds are shown in Fig. 3. A pile of castings made from these patterns is shown in Fig. 6 and a floor of molds ready to pour is shown in Fig. 7. A close up view of one of the molds is shown in Fig. 2, in which it will be noted that the casting is all in the cope. The molds on this particular floor are made on a pneumatic jolt-squeezer but in many shops they are rammed by hand either on a bench or on the floor. In the mold shown in the illustration, the cope part of the flask is set on the machine first, filled with sand and jolted. It then is turned over, the drag set on, filled with sand and squeezed. The drag is lifted off first and placed on the floor, then the pattern is drawn out of the cope, after which the riser and gate are reamed out. The core *A* Fig. 2, to form the recess at the bottom, and the chills *B* then are placed in the drag after which the mold is closed. The chills in some shops are oiled, but the popular practice is to give them a light coat of blackwash and dry them in the oven before using.

The smaller chills like those shown in Fig. 2 are solid; but large ones as illustrated at *C* in Fig 3 are lightened on the lower side. The term *chill* as applied to these devices is rather misleading inasmuch as they are not expected to *chill* the face of the casting. The entire interior face of these molds has to be machined all over, a process of course which would be manifestly impossible if the iron was chilled in the proper sense of the word, that is if the carbon was in the combined form and the iron in the condition known in the foundry as *white iron*.

Wood is used both for patterns and coreboxes, except in cases where there is a great deal of intricate detail work and ornamentation to be reproduced. Plaster of paris is substituted in such instances. The latter is a particularly convenient medium for securing reproductions from sample pieces submitted as patterns. In many cases it solves the problem of making intricate coreboxes and maintaining an even thickness of metal throughout the walls of the desired casting. In the pattern shown at *P*, Fig. 1, plaster has been used to increase the size of a wooden pattern from a 12 to a 14-inch size. At *G*, in the same figure, is shown one-half of a casting for making the mold in which the globe in the center is made.

In all pressed glass work and in the majority of blown glass objects there is a well defined seam or seams indicating the joints of the mold in which the object was made. In the globe shown in the illustration and all similar goods there is no seam or mark to indicate that they were blown in a jointed mold. The explanation lies in the manner in which the glass is manipulated

FIG. 9—OUTSIDE PART OF MOLD FOR MAKING GLASS CASKETS—THE CASTING WAS MADE IN A SKIN DRIED MOLD AND POURED IN THE POSITION SHOWN

while it is being blown. The mold is painted with oil and then dusted lightly with fine apple wood sawdust. While the blowing is going on, the blow pipe to which the glass is attached is slowly rotated to impart a horizontal motion to the globe. The sawdust acts as a buffer, cushion and lubricant, all combined and the result is a globe which does not show any sign of a mold joint. One application of oil and sawdust generally is sufficient for approximately 50 operations after which a fresh coating is applied.

A curious factor of glass, particularly pressed glass, is that the quality and degree of finish on the face of the mold is directly reflected in the product. A mold made of hard close grained iron, having a smooth and highly finished surface will produce glass goods having a much better appearance than molds made of a softer grade of iron. Furthermore, since the molds have to be scoured at frequent intervals to remove the scale which forms as a result of using oil on the face, the molds made of a hard grade of iron will give much longer service than those made of a comparatively soft grade. The molds are held to close limits as to size and when these limits are exceeded the mold has to be scrapped irrespective of whether it is in good working condition or not.

Preparing Graphite for Foundry Facing

The Canadian department of mines has issued a comprehensive pamphlet, by Hugh S. Spence, describing the production and uses of graphite. On the subject of foundry facings, Mr. Spence says: While different materials are used for this purpose, including talc or soapstone, carborundum, and various forms of carbon, such as sea coal, charcoal, coke, gas retort carbon, etc., graphite is the most important of the facing materials for mold surfaces, and large quantities are used in foundry work. Practically the only market for the low-grade dust graphite from the refining mills, which contains between 40 and 60 per cent carbon, is the foundry facing trade.

The preparation of graphite for facings, apart from the preliminary drying and crushing that may be necessary when the raw material is crude ores, such as Korean, Mexican, etc., and which are not required in the case of mill dust, involves grinding in tube mills, the product from which is air floated.

Inasmuch as graphite possesses no adhesive property, it is necessary to add a proper bonding constituent to it when used as a facing for mold surfaces. This binding material is, usually, of a clayey, refractory nature. The binder absorbs a certain amount of moisture from the mold, and this holds the facing in place; and when the clay is calcined by the molten metal, the facing is rendered somewhat porous, thus allowing the exit of moisture and occluded gases. Proper proportioning of the graphite and binder is important, since, if there is too much of the latter, peeling becomes difficult, and if too little, the graphite runs before the metal flowing in.

In applying graphite to green sand molds, it is usually dusted on and then slicked off with the tool, or else rubbed on with the hand and the excess blown away. It is also laid on with a fine brush, care being taken not to disturb the sand surface.

For dry sand work, the graphite is applied wet, in the form of a wash, the liquid used being molasses water or some other solution containing vegetable substance possessing adhesive qualities, such as the waste liquor from pulp mills—glutrin. The graphite is usually mixed with fireclay, and a syrupy mixture is obtained which is applied with a swab.

With regard to the grade of graphite best adapted for foundry facings, the best results are obtained by the use of high grade flake. This material may be adulterated considerably and yet be better than the poorer varieties of graphite. Soapstone, coke, anthracite, and even bituminous coal are often ground up with graphite in order to cheapen the mixture. The preparation of proper specifications, based upon reliable tests, is one of the urgent problems of the foundry.

In the manufacture of foundry facings, more graphite is utilized than in the making of any other article in common use, with the exception of crucibles.

Deep Etchings of Steel Reveals Defects

The method of deep etching steel by means of concentrated acids was studied by the bureau of standards and the details of the tests are given in technologic paper No. 156 of the bureau. It was found that the choice of acids is of minor consideration provided the acid is concentrated enough to produce a vigorous action. The report says that the metallographic features of steel revealed by deep etching are of three general types: Chemical inhomogeneity, mechanical nonuniformity, and physical discontinuities. Chemical inhomogeneity, usually the result of segregation, shows itself by a more vigorous roughening and pitting of the impure portions Sulphides and other inclosures are rapidly dissolved and the resulting pits are then deepened and widened.

Steel which is not mechanically uniform throughout because of the presence of initial stresses, which may be the result of previous mechanical work or of too vigorous quenching during heat treatment, will split when deeply etched, provided the stresses are of sufficient magnitude. Commercial bearing balls of different types were used to illustrate this feature. It was shown that this tendency to crack upon etching may be eliminated by suitable heat treatment. The behavior of steel, in this respect, is identical with the corrosion cracking of brasses and bronzes.

Physical discontinuities, such as internal fractures, etc., which may exist in steel, are revealed by deep etching. The acid serves to widen and deepen these discontinuities within the metal.

Incorporate New Company

The Midstates Engineering Co. recently has been incorporated with offices in the Westminster building, Chicago, to engage in industrial power and plant engineering. J. H. Milliken will direct the equipment and commercial division while the engineering work will be in charge of R. J. Gaudy, president.

Start Nitro Plant

The Central Foundry Equipment Co., which purchased a plant site in Nitro, W. Va., in March, has started operations. The site purchased by the equipment company, which is a branch of the Central Foundry Equipment Co., Columbus, O., is part of the government reservation and comprises about ten acres. The principal buildings include a welding shop, blacksmith shop, pattern shop, foundry, machine shop and assembling department. Officials of the company who are now at Nitro are W. C. Chatfield, formerly connected with the Kanawha Mfg. Co., foundry superintendent, T. S. Softly, formerly with the London Scottish Engineering Co. of London, England, superintendent of the machine shop, and J. W. McDowell, office manager.

The Brunner Foundry & Machinery Co., Peru, Ill., the Wills Mfg. Co., Mendota, Ill., and the H. B. Compressor & Pump Co., Chicago, recently have been consolidated as the Mundie Mfg. Co., Peru.

Chemical Reactions in the Cupola

Height of Fuel Bed Determines Whether All Available Heat Is Secured from the Fuel—Air Volume Instead of Air Pressure Should be Measured—Low Bed Causes Oxidized Iron

BY RICHARD MOLDENKE

THE cupola is conceded to be the easiest and cheapest melting medium for cast iron. It is the apparatus universally used for converting exactly proportioned mixtures of pig iron and scrap into highly superheated molten iron for pouring molds. Much depends upon converting the metal charged into the cupola into serviceable molten material, and the slightest deviation from standard practice may result in higher losses, particularly if much machining is done. Therefore, it is obligatory to provide for conscientious weighing uniformity in the sequence and distribution of the items making up the charges, blast regulations, etc. The first detail to watch is the height of the fuel bed. This should not only be kept at a proper height, but should remain level throughout the heat. Its height is a function of the metal and fuel proportion being charged, the blast remaining constant. The blast volume is most important, as will be understood from the following: The oxygen of the air blown into the cupola combines with the coke and evolves the heat necessary to melt the iron. It is essential that this combustion of the fuel be as complete as possible so as to convert the carbon into carbon dioxide gas. A pound of carbon in the fuel will yield 14,500 heat units when burned to carbon dioxide. However, this gas is able to unite with incandescent carbon and form another gas called carbon monoxide, and if allowed to do so by having too high a bed, the heat units produced by the pound of carbon in question will diminish to 4400. The other 10,100 heat units are lost by being locked up in the new gas which later burns as it is met by the air drawn in at the charging door. Thus about two-thirds of the available heat of the fuel will be wasted and dissipated in the atmosphere if complete combustion does not take place in the cupola. This makes it important to have the proper height of bed to get the maximum of carbon dioxide and a minimum of carbon monoxide, thus producing the highest temperature with maximum super-heat in the molten metal produced. A further point is that this position of the bed also means the practically complete utilization and elimination of the oxygen of the blast, and avoiding the dangers of oxidized metal for pouring the molds.

As the blast passes through the tuyeres it goes inward and upward through the coke bed, oxygen being used until all of it is combined, either with the fuel or with the iron or its metalloids. With a steady stream of air, the velocity of the gases formed within the bed will remain constant, and hence it is possible to adjust the bed height to be right for a given set of cupola conditions. That is, once the proper height is known, it can be kept at that point by seeing that the intermediate coke charges just replace the upper part of the bed consumed, provided the blast volume is not changed by meddling with the regulation of the blower. If the blast volume is adjusted properly to the diameter of the cupola inside the lining, it will be normal within high and low points incident to the interior conditions at the end and the beginning of a heat. Thus, with a cupola 54 inches diameter inside the lining, there should be 10 tons of iron melted an hour. This means that as 30,000 cubic feet of air are required in melting a ton of iron, air must be put through the cupola at the rate of 300,000 cubic feet per hour, or 5000 cubic feet per minute. The number of revolutions per minute of the blower can then be figured. After the correct number of revolutions per minute are established for the blower, its speed should not be changed from beginning to end of the heat.

Forcing the cupola by blowing in more air means a higher gas velocity in the bed, which must therefore be made higher to get the ideal melting position. The uncertainties within the cupola are increased under such forced conditions. Therefore, it is not good practice to force a cupola. If necessary either the heat should be lengthened or the capacity of the cupola should be augmented by increasing the diameter, if possible. On the other hand, by decreasing the blast volume below normal, the velocity of the gases within the cupola is reduced, and unless the bed is lowered there is danger of the formation of the previously mentioned carbon monoxide, with loss of efficiency in the melting operation. The tendency of the blast is to hug the lining and leave the center of the charges only partially affected, thus heaping up a cone in the center of the bed and causing irregular melting. The cupola should be operated at full capacity and, if the iron comes too fast, the blast should be completely shut off periodically to stop melting long enough to allow disposal of the molten metal. It is necessary to open one of the peep-holes in the tuyeres at least partially to prevent the gases from backing up into the blower, with disastrous consequences when again starting to melt.

An easy practical way of determining the height of the bed is available to the foundryman. He should leave the tap hole open and count the time from *blast on* to *first iron* as it runs over the spout. This should not be less than 8 minutes nor more than 10. The drops of metal passing the tuyeres should be seen in about 6 minutes. The bed charge is adjusted from day to day until these figures are obtained, and the result is the correct bed height, which with properly regulated blast conditions, should be about 24

CORRECT cupola practice is responsible for quality in the iron melted for castings. Further the correct proportioning of coke and iron conserves coke. Therefore, it is essential in producing first class castings with a minimum amount of coke to know what constitutes sound cupola practice. Some foundrymen have found the most economical way to operate their cupola but there are many who could improve on their melting process. This abstract from an article presented by Dr. Richard Moldenke at a recent meeting of the Southern Metal Trade association, held at Atlanta, giving as it does the theory as well as the practice of melting in the cupola, offers a system for comparison.

inches above the top of the tuyeres, of which there should be but one row of proper size.

The next point to watch is that the height of the bed remains normal. As the metal charges melt, the top of the bed is burned away, to be replaced by the next charge of coke. It is evident that it too much of the bed is burned away, the ideal conditions of the gases and temperatures is upset, and the melting operation becomes inefficient. On the other hand, with too low a bed, the result is worse. Probably a drop of 4 inches in the bed while melting a charge of iron is a good average, and hence the intermediate coke charges should be just 4 inches in thickness to make up for this drop. This gives the essential of the size of the charge of metal in any cupola, namely, that it be such as to require the combustion of a 4-inch layer of coke to melt the charge completely. Since under ordinary conditions of charging, it takes a pound of coke to melt 10 pounds of iron, a 4-inch layer of coke weighing, say 200 pounds means a metal charge of a ton for that particular cupola. The mistake of using a double first charge of metal is easily recognized from what has been stated, for the bed is reduced not 4 inches but 8, in melting this double charge. Then the subsequent coke layer of 4 inches will bring the bed back only part of the way. The taps will be hot and cold alternately, and the castings from metal melted at the end of each charge will be damaged by pin holes and excessive shrinkage. Every case in which the use of a double weight on the first charge has given satisfaction will be found on investigation to have been the result of an extra high bed. An unnecessary chance is taken under the mistaken impression that so large a quantity of coke on the bed should care for an extra amount of iron on the first charge, whereas the real fact is that proper and safe melting conditions are only to be had in the upper 4 inches of the bed. Below the tuyeres the bed simply acts to support the column of charges of the cupola and the spaces between the coke are filled with molten metal when it is collected for tapping.

Proper Melting Rates

The melting rate and heat condition of the metal during the run is the best guide to the height of bed after a proper start. Observation of the cutting action in the lining indicates whether the bed has been of the proper height. The patching required should be confined to a zone less than a foot wide and not too low down. Adjusting the intermediate coke charges from 10 to 1 to perhaps 9 to 1, or in cases of high steel scrap percentages even 7 to 1, will maintain the proper height of bed throughout the heat.

The order of charging should be steel, pig and heavy sectioned scrap, and finally light scrap. The higher melting point of steel, heat absorption requirement of heavy sections of metal, and distance of light pieces from the bed in such a charging sequence result in melting the whole material together. Charging the steel last means that it melts with the pig and scrap of the charge above. When each of the materials is spread evenly over the cupola cross section, melting will be uniform. One of the worst methods of charging is the placing of the pig iron around the rim of a charge, with the light scrap in the middle. The melting ratio at the rim may be 16 to 1 and that in the middle 5 to 1. This can only mean burned iron at the rim mixing with good metal in the center, and the result is defective work heaped in the scrap pile.

Slagging should be resorted to in longer heats, usually, in ordinary practice, after the heat is on for three-fourths hour. The limestone used should be as nearly pure carbonate of lime as may be obtained. Seldom more than 1 per cent of this flux is necessary with reasonably clean metal. In general, the problem of cupola melting is an extremely simple one once the underlying principles are understood. A bed of proper height, small charges evenly distributed, and a blast of uniform volume sums up the whole situation. How easy, and yet how rarely carried through to the dot.

Cupola Run as Gas Producer

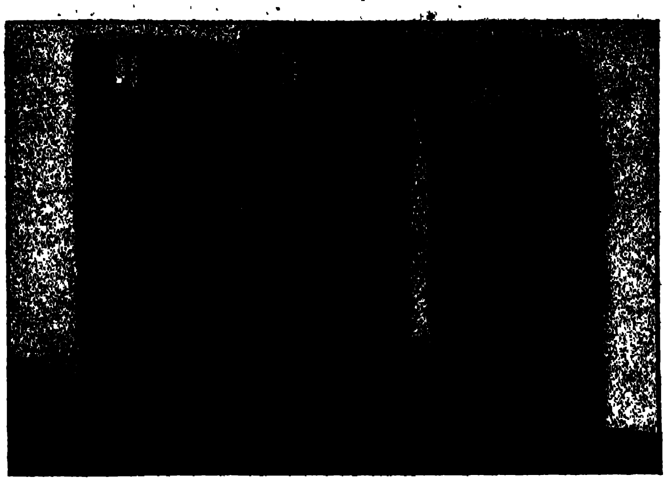
Now for the bad effects of improper melting practice. Too high a bed means that the cupola is running partially as a gas producer. The iron is melted too high up, where the bed is no longer at maximum incandescence. The result is that the individual drops of metal are not given sufficient super-heat where they form, and do not acquire it in passing through the hottest portion of the bed below. There is no time for this. Therefore, while the iron may be good so far as quality is concerned, it is too cold for regular work. Too low a bed, on the other hand, means equally cold iron, for it has been melted below the point of maximum temperature of the bed. There has been however, an exposure to free oxygen still in the blast, and the consequence is a dissolved iron oxide which raises the freezing point to such an extent that this iron cannot be held in the ladle for any length of time. It has no life, as the foundryman designates the condition, and must be poured quickly. When an iron such as this is poured into the mold, it sets too fast for proper feeding, the gates are cut off too quickly, and the result is serious internal shrinkage. More than this, the quantity of dissolved gases is great, and a reaction between any oxygen present and the carbon, which may still go on while the molten metal sets in the mold, results in gas bubbles. These rise and are caught by the skin of metal already formed. Later they are revealed when the castings are machined. Besides this, the undue casting strains, cracks, coldshuts and other troubles result. The old foundry remedy of cutting in two the metal and coke charges, usually resorted to when things get desperately bad, is an instinctive feeling that all is not well with the fuel bed. Indeed the cutting in half of the distance the bed may go up and down during the melting by using half-sized charges, is exactly in line with the scientific correction of the trouble. It is the heavy fluctuation of the height of the bed that accounts for the fact that good and bad castings are made from the same charges, the molding conditions being right. The last portion of every charge, if too large, gets down too low and the resulting molten metal is damaged correspondingly by contact with free oxygen from the blast.

Incorporates Steel Plant

E. C. Hummel recently purchased a controlling interest and has incorporated the Philadelphia Electric Steel Corp. The latter, which was controlled by the American Metallurgical Corp., Philadelphia, under its new organization will be known as the Philadelphia Electric Steel Castings Co. It is the intention of the new management to handle the plant for the manufacture of steel castings and special steel alloys. Mr. Hummel is president and general manager, F. J. Ryan, vice president and treasurer, and F. H. Schrenk, secretary. C. T. Hess and R. V. Mitchell are directors.

J. I. Capps recently has been appointed purchasing agent for the American Manganese Steel Co. with offices at Chicago Heights. Mr. Capps succeeds N. C. Peebles who will devote his time to sales work.

The Air Reduction Sales Co. recently has completed new additions to its acetylene plant in Gloucester, N. J.



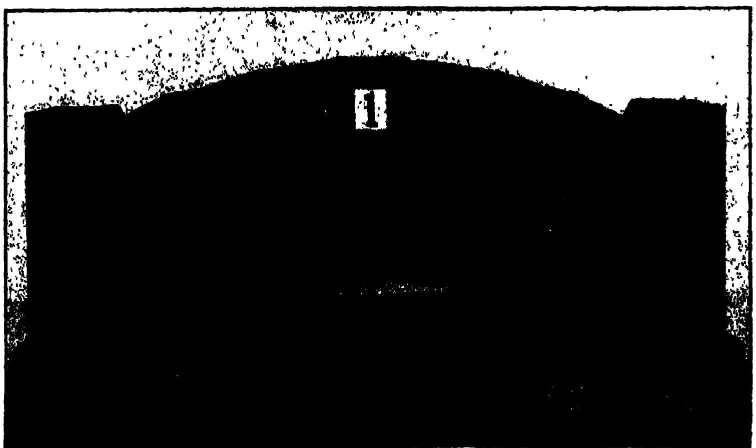
TYPICAL example of the effect of heat upon a refractory mortar containing about 10 per cent of asbestos and 10 per cent of water glass. Firebrick piers were built using this mortar in the joints and after drying, the piers were subjected to a pressure of 11 pounds per square inch and heated. Column No. 1 in the accompanying illustration shows one of the columns before being heated. No. 3 shows the expansion of the mortar after heating to the temperature of 1100 degrees Cent. Pier No. 5, at the right shows the condition of the mortar after being heated to the temperature of 1250 degrees Cent. At this point the mortar had reached a semifluid state and was forced from between the joints.

Analyzing Mortar For Firebrick

Adding Foreign Materials to the Mortar Used in Laying Firebrick Frequently Reduces the Refractoriness of the Lining — Tests Show Ground Brick and Clay Make Effective Mixture

BY RAYMOND M. HOWE

IN MAKING so-called firebrick mortars, it is common practice to add certain materials to the ground fireclay. At times these materials are added by the manufacturers of the mortar, while in some instances they are added by the mason entrusted with the laying of the brick. Such materials are generally added to make the mortar set firmly without the application of heat, to offset the natural shrinkage of the clay, or to cause it to burn to a dense structure by reason of decreased refractoriness. Ground silica and alumina are often added, and since the clay itself is composed almost entirely of these materials, this practice is perfectly legitimate, in fact, the general properties of plastic clay can often be improved by making such additions. On the other hand, it is evident that the addition of certain other materials is not justified and this article is intended to show the effect of such additions. In the experiments here reported, a plastic fireclay was selected and different amounts of water glass, salt, portland cement, carborundum, asbestos and lime were added. The analysis of the original fireclay in per cent is as follows: Ignition, 11.12; silica, 56.42; alumina, 28.46; ferric oxide, 3.12; lime, 0.52; magnesia, 0.44; and alkalies, 0.24 per cent. The fusion point of this mixture was cone 30. After the various mixtures were compounded, small samples of each were tested in the usual type of furnace used in making such determinations. The results of this work are given in tables I to VI inclusive. A careful examination of these data shows clearly how seriously the addition of lime, portland cement, asbestos and salt affect the quality of fireclay, the addition of only 5 per cent of these materials lowering the fusion point about 200 degrees Fahr. Water glass and carborundum



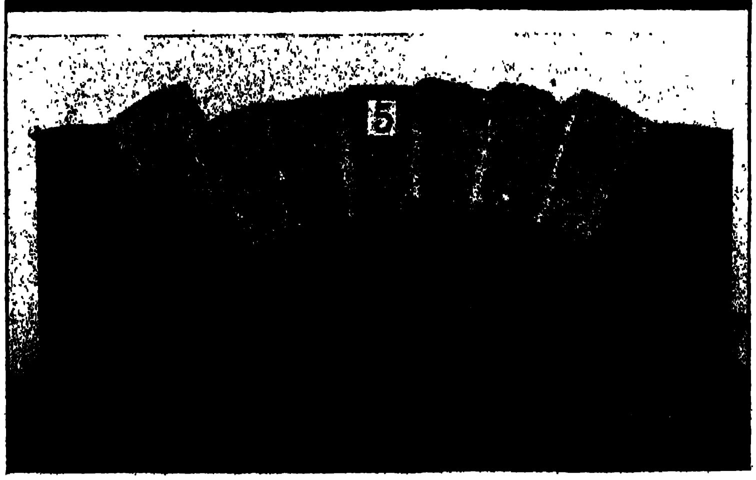


FIG. 2—A TYPICAL ARCH CONSTRUCTED WITH THE SAME MORTAR IN THE PIERS AS IT APPEARED BEFORE HEATING FIG. 3—APPEARANCE OF A SIMILAR ARCH HEATED TO 1250 DEGREES CENT.

From a paper presented at the recent Chicago meeting of the Refractories Manufacturers' association. The author, Raymond M. Howe, is senior fellow on industrial fellowship of Refractories Manufacturers' association, Mellon Institute of Industrial Research, Pittsburgh.

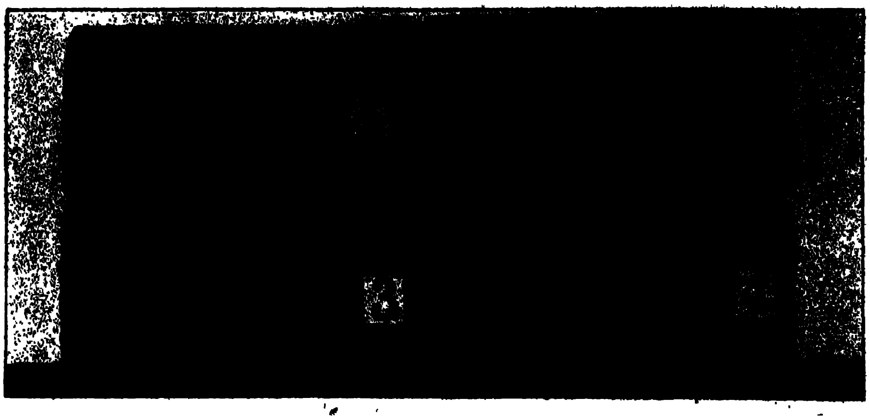


FIG. 4—EFFECT OF SHRINKAGE IN MORTAR VARYING FROM 25 PER CENT CLAY AND 75 PER CENT GROUND BATS TO 100 PER CENT PLASTIC CLAY

did not exert so marked an influence. The combined effect of the addition of asbestos and water glass to fireclay may be appreciated more fully if a mortar of the following composition be studied. The chemical analysis indicates that about 10 per cent of each of these materials was added to fireclay or silica cement in making the mortar. The analysis follows: Ignition, 8.94; silica, 72.96; alumina, 7.64; ferric oxide, 1.11; lime, 0.34; magnesia, 3.01; and alkalies, 6.76 per cent. The fusion point was below cone 11. The mortar was used in making the joints of several firebrick piers. After being dried they were placed under a pressure of 11 pounds per square inch and heated. Fig. 1 shows the effect of such treatment, the column marked No. 1 showing a pier before being heated. The column marked No. 3 shows the effect of heating to 1100 degrees Cent. and the column labeled No. 5, the condition of a pier after being heated to 1250 degrees Cent. Arches were then constructed, using the same mortar in the joints. Fig. 2 shows a typical arch before being heated, while Fig. 3 shows a similar arch after it had been heated to 1250 degrees Cent.

These tests were convincing in that although the addition of these materials improved the working and setting properties of the mortar, mortars so made should not be used at high temperatures. If they are used, the foreign ingredients should be used in very small amounts. However, fireclay, when used alone, does not give a satisfactory joint for some purposes.

Much of the dissatisfaction which has attended the use of fireclay to which no foreign material had been added can be traced to the shrinkage of the fireclay during the application of heat, for if this tendency to shrink could be overcome, the joints would be firmer, tighter and would not fall out of the arches. A more logical way to prevent this shrinkage and so establish a firmer joint is not to add foreign materials to the fireclay, but to use the same material, taking the precaution, however, to add a certain amount of shrunken clay.

To demonstrate this, some bats of first quality brick were finely ground and mixed with the same fireclay as was used in the other experiments. The effect of this addition upon the fusion point of the clay was decidedly favorable and is shown as follows:

Proportion Clay Per cent	Bats Per cent	Fusion point Cones	Fusion point Degrees Cent.
100	0	30	1730
75	25	30–31	1740
50	50	31	1750
25	75	31–32	1760

The effect upon the shrinkage is shown in Fig. 4, where mixture No.

Influence of Materials Added to Fireclay

Table I

Fire Clay and Portland Cement

Proportion Clay Per cent	Cement Per cent	Fusion point Cone	Fire point Degrees Cent.
100	0	30	1730
96	4	27	1670
94	6	20	1530
92	8	19	1510
90	10	15	1480
80	20	13	1390
70	30	11	1350
60	40	8	1290

Table II

Fire Clay and Lime

Proportion Clay Per cent	Lime Per cent	Fusion point Cone	Fusion point Degrees Cent.
100	0	30	1730
96	4	20–26	1590
92	8	17–18	1480
88	12	11	1350
84	16	10	1330

Table III

Fire Clay and Asbestos

Proportion Clay Per cent	Asbestos Per cent	Fusion point Cone	Fusion point Degrees Cent.
100	0	30	1730
97	3	28–29	1700
94	6	19–20	1520
91	9	18–19	1500

Table IV

Fire Clay and Water Glass Solution

Proportion Clay Per cent	Water glass Per cent	Fusion point Cone	Fusion point Degrees Cent.
100	0	30	1730
96	4	29–30	1720
92	8	29	1710
88	12	28–29	1700
84	16	26–27	1660
80	20	26	1650
76	24	20	1530

Table V

Fire Clay and Salt

Proportion Clay Per cent	Salt Per cent	Fusion point Cone	Fusion point Degrees Cent.
100	0	30	1730
95	5	26	1650
90	10	14	1410
85	15	5	1230

Table VI

Carborundum and Fire Clay

Proportion Clay Per cent	Carborundum Per cent	Fusion point Cone	Fusion point Degrees Cent.
100	0	30	1730
95	5	29	1710
90	10	29	1710
85	15	29	1710
80	20	29	1710
70	30	29	1710
60	40	29	1710
50	50	29	1710

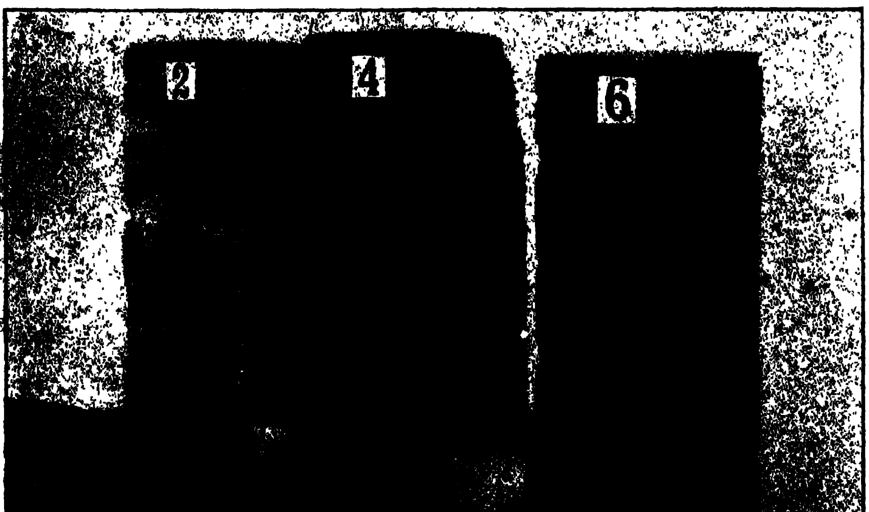


FIG. 5—PIERS BUILT WITH MORTAR OF HALF CLAY AND HALF GROUND BATS—NO. 2 HAS NOT BEEN HEATED—NO. 4 WAS HEATED TO 1250 DEGREES CENT. AND NO. 6 TO 1350 DEGREES CENT

1 is 25 per cent plastic clay and 75 per cent ground bats; mixture No. 2, equal quantities plastic clay and ground bats; No. 3, 75 per cent plastic clay and 25 per cent ground bats; and No. 4 all plastic clay. It can be seen that No. 2, containing half plastic clay and half ground bats is far superior to No. 4 which is plastic clay alone. Laboratory tests also showed that the joints made from the mixtures of half ground bats and half plastic clay were stronger than those made from plastic clay alone.

Before passing final judgment upon the merits of such a mixture, however, it was decided to subject it to the same tests as were applied to the mortar previously described. Fig. 5 shows the results of the tests, column No. 2 not having been heated, No. 4 having been heated to 1250 degrees Cent. and No. 6 to 1350 degrees Cent.

The results of the arch tests are shown in Fig. 6, this arch having been heated to 1350 degrees Cent. It will be noted that these joints are firm and strong and that they have not begun to soften. Such joints are stronger when highly heated.

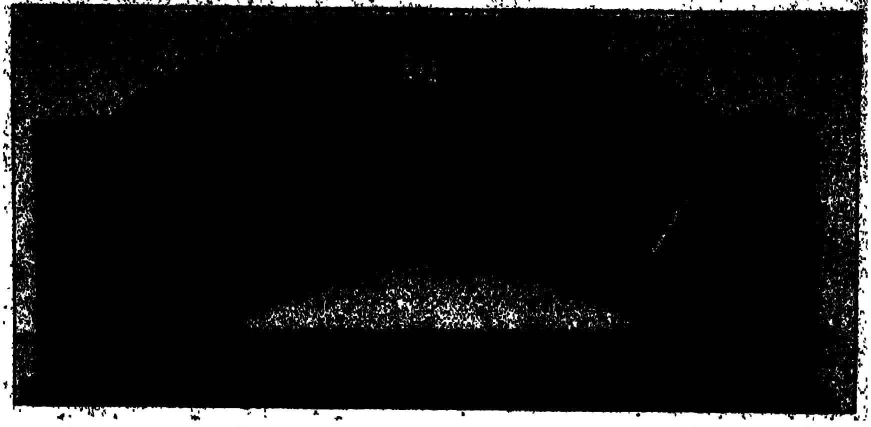


FIG. 6—THIS ARCH WAS MADE WITH MORTAR HALF CLAY AND HALF GROUND BATS AND WAS HEATED TO 1350 DEGREES CENT.

No Marked Break in Demand Expected

BY FREDERIC B. STEVENS

IF, AS the old adage puts it, "misery loves company," it is consoling to know that several hundred years ago the immortal Hamlet is reported to have said "The time is out of joint."

The commercial joints that have articulated so uniformly in the years that are forgotten are now halting progress on the one hand and hurrying it on the other. To speak in a general way, and to judge only by the immediate and superficial situation, one might confidently say it is only in the distant and uncertain future when the supply of basic materials, including their delivery by transportation lines, will catch up with the demand. That there is coal enough, be it hard coal or soft coal, nobody questions, but to get it to the place of needed consumption is the great problem.

That is equally true of fireclay, so much required for mechanical purposes, and which may be so easily mined with a steam shovel or hand shovel, but now it wastes its sweetness beside the way-station, in the states of Ohio and Pennsylvania, where, at this time, empty cars do not linger. It is so near and yet so far. To be more certain of shipments, the manufacturer who buys extensively for his own use and the operator of the supply warehouse who serves others, must send his men to the basic source of supply to beg and plead for shipments; to exercise his influence if he possesses that charming characteristic, in an effort to procure empty cars, and today large consumers are in the soft coal mining region and are offering premiums for quick shipment of cars. The stimulating influence of an extra dollar per ton is said to be more resultant than the wonderful work of Aladdin's Lamp, but the danger is that the avarice of that mining operator, already somewhat overgrown, will become permanently enlarged and the premium price for one will become the general price for all. The same situation applies to shipments of pig iron and of coke. The winter calendar has concealed in its folds not only the return of snow flurries but a few heatless days in mid-winter are quite liable to be included. The assurances, of which we now and then read, of coal in abundance at the mines is quickly dispelled when one tries to buy an extra carload.

Small Gain Made

It little matters whether one is in jail for something done and for which there is no warrant for so severe a penalty, or whether one is freezing to death when there is plenty of caloric 50 miles away; the physical condition in either case is no more joyful. Perhaps an improvement is in sight, for last week the railroad group made it known to the interstate commerce commission that a freight increase of 30 per cent is necessary to bring a return of 5½ per cent on capital invested by railroad corporations. The commission has delegated the power by congress to fix rates which will bring that return. It still remains to be seen how that increase can cause rolling stock to be provided, quick enough, to move the freight for which there is such an immediate demand. However, back of this cloud there is some sunshine for the human procrastination of the average buyer which caused him to wait until the fifty-ninth minute of the eleventh hour will be corrected by sad experience and he will realize he must, hereafter, take time by the forelock and by the fetlock or get left by the procession. With most manufacturers the demand is at the top-notch; the great obstacle is freight delay; there are, however, others.

The building trades, who gracefully took their medicine during the war period and bided their time, welcomed the spring opening, believing their reward at hand. It was, for a short months, then it vanished, and now it is in the moribund condition which indicates dissolution, and the sellers of building material are sitting, not like Patience on a monument, but in their swivel chairs, smiling at grief. The demand, however, is in evidence and increasing every day, and so the lost time now will be made up later.

You may dam up a stream of water, but when the dam breaks the retarded quantity all comes on with greater force.

This is a time of great opportunity; the time when capital and labor should confer together; when neither should flock alone; when differences, where differences exist, should be adjusted and labor compensation be fixed not in dollar units alone, but in the dollar purchasing value and with the clear understanding that an honest day's work shall have an honest day's pay.

Heat Treatment of Steel Castings

Crystalline Growth Induced by Too Hot Metal Heating Molds Which Hold Temperature Near Solidifying Point of Steel for a Long Time—Impurities Absorbed from Spout and Ladle Refractories

BY A. N. CONARROE

WHEN the problems involved in the heat treatment of steel castings are studied they are found to be of a dual character; those belonging strictly to the heat treating department, and those belonging to the metallurgical department. Since practically all steel castings are heat treated by the manufacturer whose object is to put out a superior product, these problems merge into one for him and are discussed as such in this paper. The greater emphasis is placed upon the metallurgical side of the question, for, the better the steel submitted to the heat treater, the easier his problem becomes and the greater his assurance of turning out a uniform and high-class product.

In the manufacture of steel castings the usual procedure is to so regulate the furnace that the metal will have a high fluidity by the time the carbon and metalloids have been reduced to the desired amount. The metal is then killed by the addition of deoxidizers and recarburizers, either in the furnace or in the ladle, according to the process of manufacture. In his desire to assure himself that the metal will be sufficiently fluid to fill all the molds properly, the melter sometimes heats the fluid to too high a temperature, and the molds consequently are overheated during the casting operation. These molds, being extremely hot, keep the castings from cooling quickly after solidifying, and thus hold the temperature in the granulating range for a considerable time. This condition is ideal for the production of excessively large crystals, and a coarse-grained product results. This coarse-grained condition is called *ingotism* and exists in all castings of very large section, when slowly cooled in sand molds. In like manner, when castings are held too long in the molds after pouring, the same condition arises and a coarse-grained product is the result. Sometimes, under slow cooling conditions, especially when the metal is phosphoric, the crystalline growth occurs by linear deposition and sets up a pine-tree-like form of crystallization, called a dendrite. In this case the impure metalloids are rejected to the boundaries of these tree forms and set up a segregated area, which is very difficult to eliminate.

The above conditions are properly metallurgical and can be prevented or controlled to a considerable degree by keeping the composition of the material right and using a normal casting temperature. Likewise, the castings should be drawn from the sand as soon as danger of excessive scaling is past. However, should these conditions exist in the castings coming to the heat treater, he must so treat them as to break up these structures and leave a properly refined structure in the material. Large crystalline structure can be eliminated by heating considerably above the critical range and allowing to cool and then reheating to a lower temperature, holding the material long enough at these temperatures to insure the penetration of the heat to the center. The material is then allowed to cool to atmospheric temperature, either in the furnace or in the air, depending upon the properties desired in the finished product. Dendrites are more difficult to eliminate and require drastic measures. These take the form of high heating above the critical range and quenching to prevent the redeposition of the phosphoric segregates, followed by a heating to a lower temperature within the critical range to further refine the grain structure.

When steel has not been thoroughly killed by the deoxidizers, it gives off gases, on solidifying, which have been dissolved in the liquid metal. These gases, in trying to escape through the pasty metal, form cavities, called blowholes, which give the castings a honeycombed appearance and cut down the effective area for resistance to stress. Likewise, the gases, remaining in solution, have a depressing action on the critical point of the steel at these points and cause exaggerated crystal growth. The elimination of this condition lies in working the liquid charge before tapping, so as to leave always sufficient residual manganese to unite with the dissolved oxides, and proper killing in the ladle.

However, when this condition does exist in the castings, the heat-treater is called upon to restore the proper strength to the material. This is accomplished by a double treatment, first refining the normal part of the casting and then the oxidized portion. Another form of gas pockets also exists in steel castings. It results from pouring the metal into molds which are not sufficiently dry or not properly vented. The hot metal reacts upon the facing sand and core in the mold, giving off gases, which cannot properly escape through the dense sand, and the result is a porous section in the casting at this point. Due to the fact that the entrapped gases, in cases of this kind, nearly always contain a considerable amount of air, the surfaces of these cavities nearly always present an oxidized appearance and microscopic examination reveals the fact that, in many cases, the surrounding metal has been decarbonized to a considerable degree. This decarbonization leaves an excess of ductile ferrite at these points, which reduces the strength of the section. In cases of this kind a treatment to develop notch toughness in the surrounding unaltered material is best, so that, as the ferrite yields under stress, the strain will be taken up by the stronger material.

Cavities are also brought about through shrinkage, where the sections of the castings are varied. The heavier sections of the castings remain in the fluid state longer than the thin sections and, if they are so located in reference to the gate that they cannot be properly fed by the liquid metal as the casting solidifies, shrinkage occurs and the gases contained in the metal form pockets, or cavities, at these points. Sometimes these pockets have small openings leading to the outside air, in which case the gas entering the pocket is of an oxidizing nature and the surface of the cavity appears oxidized. This condition also may bring about decarbonization of the surrounding metal. Sometimes very small cracks are found radiating outward from such cavities and these act as planes of slip when the material is put under stress. If the surfaces of these minute cracks are not oxidized, they are sometimes eliminated by heat treatment, but an oxidized condition precludes uniting of the parts. Shrinkage due to difference of section may be eliminated in two ways—by casting with

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Paper presented by A. N. Conarroe at a recent meeting of the American Steel Treaters society. Mr. Conarroe is metallurgist, the National Malleable Castings Co., Melrose Park, Ill.

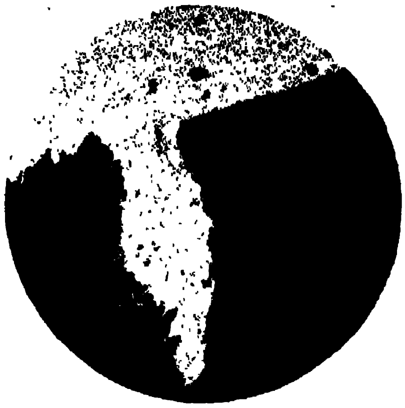


FIG. 1—SILICATE OF MANGANESE INCLUSION IN CAVITY. UNETCHED.

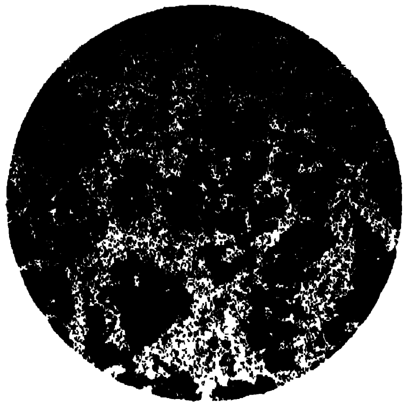


FIG. 2—FERRITE SEGREGATION ARRANGED ABOUT SONIMS AS NUCLEI

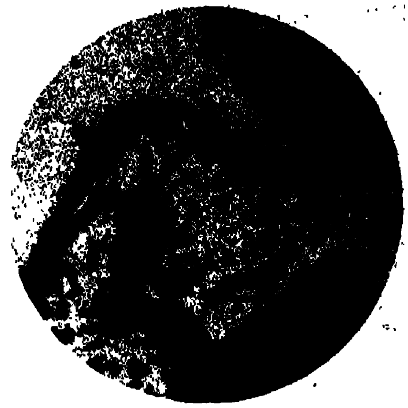


FIG. 3—CRACK DUE TO CAVITIES CONTAINING SILICATE OF MANGANESE

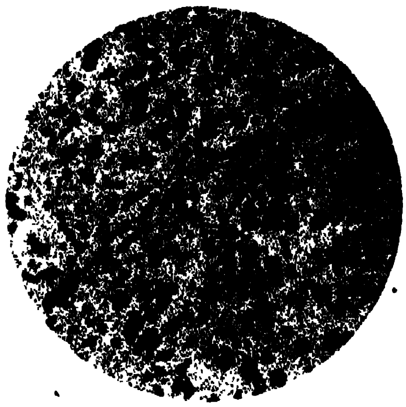
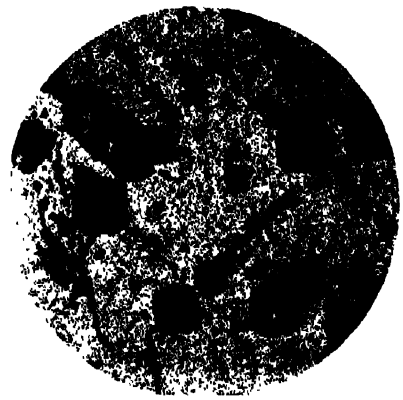


FIG. 4—MICROGRAPH SHOWING INTRACRYSTALLINE FILMS OF IRON SULPHIDE



—MICROGRAPH SHOWING CRYSTALS OF PHOSPHIDE OF IRON

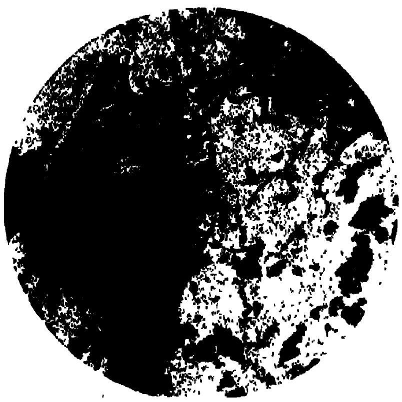


FIG. 6—SMALL CRACKS RADIATING FROM SHRINKAGE CAVITY

FIG. CRACK EXTENDING INTO THE DECARBONIZED AREA

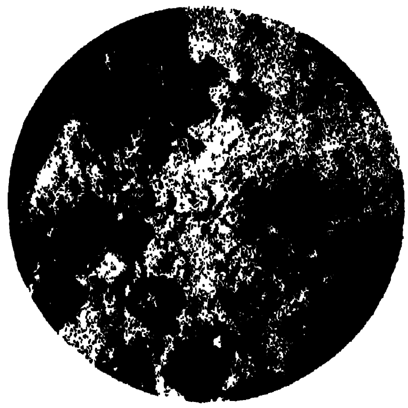


FIG. 8—DEEP ETCH SHOWING CUBIC CRYSTALLIZATION OF PHOSPHORIC IRON

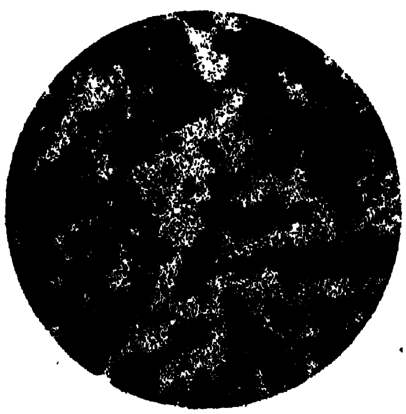


FIG. 9—DENDRITIC STRUCTURE NORMAL TO A CURVED SURFACE

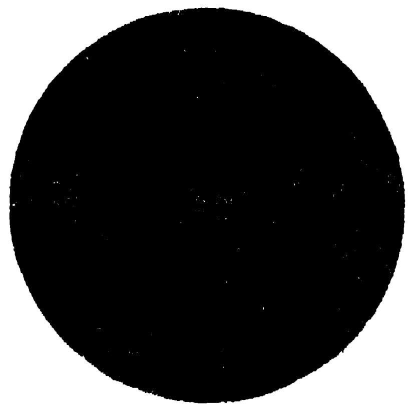


FIG. 10—REMAINS OF UNABSORBED DENDRITIC STRUCTURE

a feeding head at this point, or by the use of chills to cause the heavier section to solidify more quickly. One of these two methods is followed, where the design of the casting cannot be changed to remedy the condition.

When steel is in the molten, unfinished state in the furnace, sulphide of iron, ferrous oxide and various other impurities are dissolved in it, and it holds in suspension magnetic oxide of iron and silica. The ferrous and magnetic oxides are derived from the oxidized portions of the charge and from the ore additions in oring down previous to tapping. Thus the control of oxidation in the charge depends in a measure upon the condition of the scrap making up part of the charge. Therefore scrap which is badly rusted should be used with caution if a high-grade product is desired. The silica present in the unfinished steel, results from the oxidation of the silicon in the pig iron and scrap. When an excess of manganese is present in the charge, this reacts with the oxides and sulphides of iron to form manganous oxide and manganese sulphide. The manganous oxide formed has a great combining power for silica to form silicate of manganese. This latter agglomerates or coalesces into fairly large semimolten particles through the agitation of the bath and passes out into the slag. Likewise, the manganese sulphide coalesces into small spheres and passes into the slag. If there were sufficient manganese present, these reactions would continue till the unfinished metal was entirely free of oxidation and the sulphur reduced to a minimum.

However, in most cases insufficient manganese is present and the deoxidation is completed in the spout or ladle, ferrosilicon and ferromanganese being added for that purpose. The ferrosilicon reacts vigorously with the remaining oxides, forming silica, which is churned up into the metal as it falls into the ladle. The manganese from the ferromanganese is also oxidized and, being in intimate contact with the silica resulting from the ferrosilicon, reacts with it to form silicate of manganese. These small globules are churned up with the metal, pouring from the furnace and the result is a fluid metal containing millions of globules in suspension. If the metal is sufficiently fluid these particles will agglomerate in time and float upward to unite with the slag. The residual iron sulphide in the unfinished steel reacts with the manganese in the ladle to form manganese sulphide, which remains suspended in a semimolten state and gradually floats up to unite with the slag. If the amount of ferrous sulphide is fairly large, it unites with the manganous sulphide to form a low melting eutectic, which is frequently found along the grain boundaries of steel fairly high in sulphur content. Sometimes aluminum is used as a deoxidizer, in which case infusible oxide of aluminum is formed and passes into the slag if given sufficient time to rise through the mass of metal.

The conditions mentioned thus far are metallurgical and would indicate that it is best to maintain a high casting temperature and hold the steel in the ladle long enough to allow the reaction products to rise to the top. If this were the only source of foreign inclusions, the problem would be simplified, but the molten metal cuts away the refractory linings of the spout, ladle, pouring box and pouring heads. When these refractory linings become highly heated, the reaction products of the deoxidizers unite with them to form fusible silicates, which increase the number of foreign inclusions in the molten steel. This is an argument against too high a casting temperature, for the gain in fluidity would be offset by the increase in the number of foreign inclusions. If the metal is not sufficiently fluid and is not held in the ladle long enough before teeming, the castings will contain more or less foreign inclusions from these sources. These inclusions have been called sonims, the name being derived from, and meaning solid nonmetallic impurities. An analysis of these silicate inclusions clearly shows the origin of this material to be the combination of the reaction products with the clay or loam of the refractory linings. If the castings are fairly large, the sonims are found higher up in the castings, while smaller castings usually contain them equally distributed. If the particles are small and rounded, they exert very little influence upon the strength of the material but, when present in large numbers or spread over a certain section they are very detrimental in their influence.

Alpha iron belongs to the cubic system of crystallization and, since silicate of manganese also belongs to this same system, the sonims offer nuclei for the deposition of the excess ferrite of hypoeutectoid steels, thus causing the formation of large ductile areas of ferrite segregation. If the sonims are fairly close together, these areas join to form one large mass, which is fairly difficult to reabsorb. These areas, together with dendritic structure, give rise to the hazy spots called *ghosts*, which appear upon etched specimens, when this condition is not entirely eliminated. It is nearly always necessary to resort to double heat treatment in order to prevent the redeposition of these ferrite structures.

When there is insufficient manganese present to react completely with the iron sulphide, the residual sulphide remains molten and is deposited along the grain boundaries of the material. This forms an intercrystalline film which has very little strength and, when such material is put under stress, rupture takes place with a conchoidal fracture along the grain boundaries. In a like manner, when the molten metal is passing from the liquid to the solid state and strain is set up through shrinkage, the metal gives way along these films and causes shrinkage cracks. A treatment to give notch toughness is necessary in cases of this kind.

Another source of foreign inclusion in castings is the material washed from the molds during the operation of teeming. If the gate is improperly located in reference to the vital parts of the castings, this scum or mold wash may be carried into the section which must stand the severest service and lower its strength to a remarkable degree. Tensile test coupons, cast in such a position that they receive the wash from the mold, nearly always show a good yield point and high tensile test but fail on elongation and reduction of area. This is due to the formation of intercrystalline films, decarbonized areas, or ferrite segregation and is the result of the position of the piece in reference to the gate. Coupons from the same material, located properly, would give excellent results.

The two following tests of medium carbon steel are typical of the above condition:

Sample	No. 1	No. 2
Yield point, lbs. per sq. in...	38,706	39,216
Tensile strength, lbs. pe sq. in..	79,959	78,431
Elongation in 2 in., per cent..	15.5	11.5
Reduction of area, per cent....	22.91	19.36

It might be concluded from the foregoing that:

The composition of the product should be kept uniform and especially so in regard to phosphorus and sulphur.

The residual manganese in the bath should be kept as high as possible before tapping in order to completely deoxidize the metal.

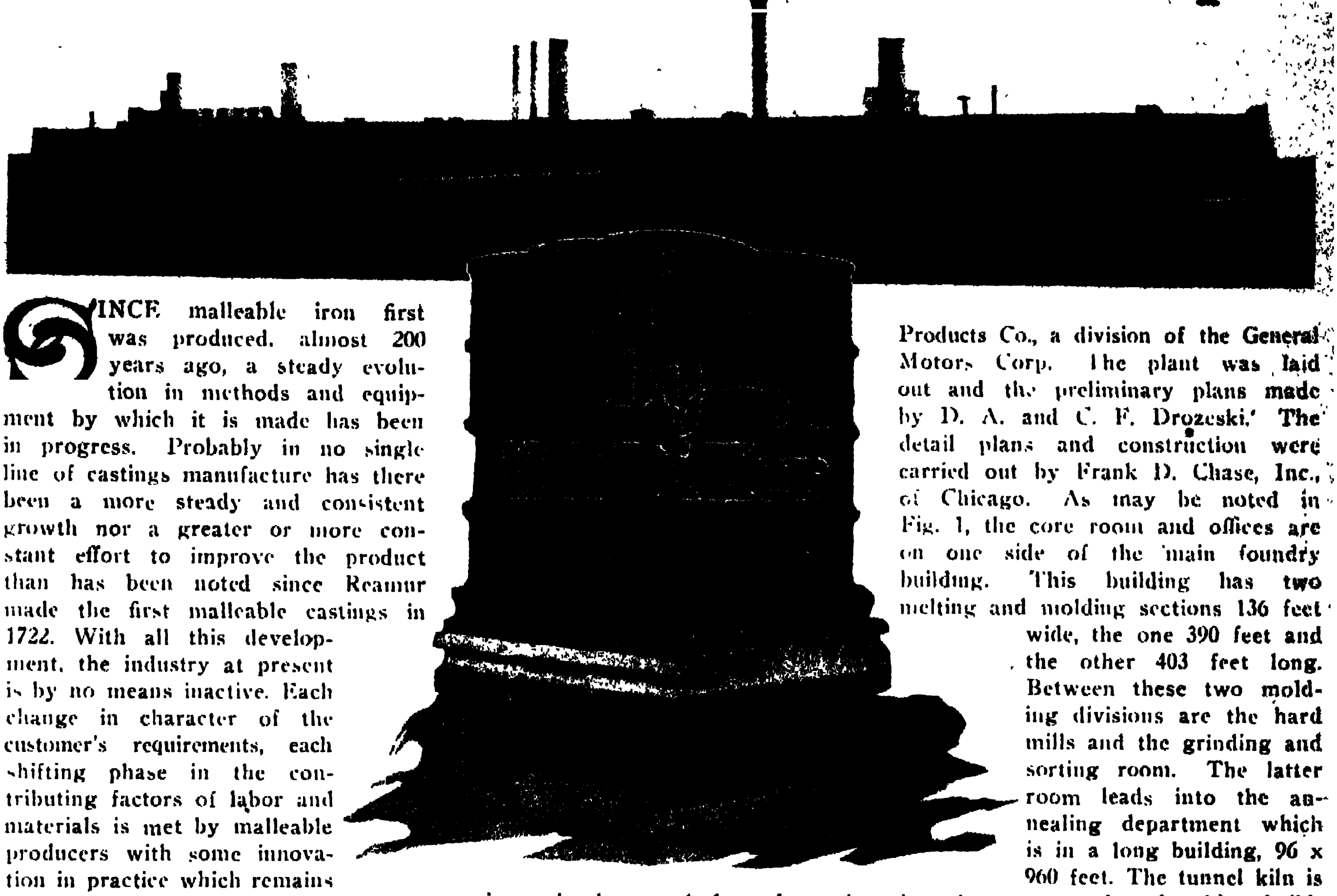
The deoxidizers should be added in such a form as to intimately mix with the molten metal.

The casting temperature should be high enough to give good fluidity to the metal, but not so high as to cause undue cutting of the refractory linings or overheating of the molds.

The refractory linings should be of a good grade to withstand the scorifying action of the metal.

Heat treatment must be of such a nature that all sections of the castings are properly refined. This often necessitates a double treatment to secure the result which are desired.

Innovations Increase Unit Output



SINCE malleable iron first was produced, almost 200 years ago, a steady evolution in methods and equipment by which it is made has been in progress. Probably in no single line of castings manufacture has there been a more steady and consistent growth nor a greater or more constant effort to improve the product than has been noted since Reamur made the first malleable castings in 1722. With all this development, the industry at present is by no means inactive. Each change in character of the customer's requirements, each shifting phase in the contributing factors of labor and materials is met by malleable producers with some innovation in practice which remains to mark a step in industrial advancement.

In melting practice, forced draft has supplanted natural draft, and powdered coal or oil has taken the place of hand fired lump coal in many establishments. The introduction of molding machines, lifting, conveying and manipulating machinery has met with marked favor throughout the malleable industry. The heavy annealing pots in which the hard castings are placed have constituted a handling problem which readily has ben solved by various types of charging machines and trucks. Annealing ovens have been designed and redesigned to meet changing conditions in fuel and labor factors. Further a steady effort has been exerted to shorten annealing time and recent innovations in oven design have had this end in view.

Recently a most radical advance step has been taken by the Saginaw Malleable Iron Co., Saginaw, Mich., through the installation of a continuous annealing kiln. This unit, which was the result of years of experiment in the search for refractories which would meet the requirements of a malleable annealing oven, is built upon knowledge acquired from the pottery and tin plate industries.

The annealing kiln, of course, is the most recent innovation at the Saginaw foundry, but it represents only of the many features which go to make this one of the most modern progressive plants of the country.

THIS is the first of three articles which present a complete study of a truly remarkable malleable iron foundry. In this establishment are combined the ideal attributes for industrial success: practical and theoretical knowledge backed by adequate capital and business courage. In the following pages, a general outline of the features of the plant will be discussed, and some examples of molding and coremaking procedure presented. The succeeding articles will give complete data on an entirely new type annealing furnace, and will offer an analysis of the production control and time study by which exceptional output is secured.

The company was organized in 1916 and was financed chiefly by local capital. During 1919 the General Motors Corp. took over the plant, which is now a part of the Saginaw Products Co., a division of the General Motors Corp. The plant was laid out and the preliminary plans made by D. A. and C. F. Drozeski. The detail plans and construction were carried out by Frank D. Chase, Inc., of Chicago. As may be noted in Fig. 1, the core room and offices are on one side of the main foundry building. This building has two melting and molding sections 136 feet wide, the one 390 feet and the other 403 feet long. Between these two molding divisions are the hard mills and the grinding and sorting room. The latter room leads into the annealing department which is in a long building, 96 x 960 feet. The tunnel kiln is in the one end of this building. Next to it is a room containing 11 annealing ovens of the standard type which were used before the tunnel kiln was put in operation. The soft tumbling mills are in a compartment beyond the annealing room and between it and the shipping department at the end of the building. This arrangement of buildings facilitates both incoming and outgoing shipments which are handled over the tracks of the Pere Marquette railroad. The track along the core room, shown in Fig. 1 is on the ground level. Core sand and furnace brick are received on this track and stored in the bins. Space on both sides of the two brick sheds serves as pig iron storage. With this arrangement each of the four melting furnaces has its own pig iron storage yard, as will be more fully explained later. The track between the molding and annealing departments is elevated to facilitate unloading sand and coal. Molding sand and sand for furnace bottoms is received on this track and stored in the sheds as marked. Coal is brought on this elevated track and

dumped for use in the boiler house immediately back of the building. It is piled against the building and shoveled through a door directly into the boilers. This track also serves for receiving shipments of oil which is conveniently run into the storage tanks indicated to the left of Fig. 1. These tanks have a capacity of 310,000 gallons, and are equipped with steam pipes for heating them in the winter.

As has been mentioned, each furnace has its own pig iron and annealed scrap storage yard. These yards are located outside the building opposite to each melting furnace. Every car of pig iron is piled separately and marked with the car num-

metal is melted at the rate of a ton in 11 to 12 minutes. Originally these furnaces were fired with coal but owing to the difficulty in securing melting coal the end of last year, the furnaces were changed to burn oil, as may be noted in Fig. 3. The burner was supplied by W. N. Best, Inc., New York. It operates with 25 pounds pressure on the oil line, while the air registers 7 inches pressure on a water gage. A top blast is admitted through the wind bung by suitable pipe connections.

To charge the furnace the bungs over the hearth are removed. The wood skips are brought to the furnace and raised by a crane which travels over each furnace. Two crane

mersed in the metal and cause a violent bubbling which, it is thought, gives the bath a more uniform mixture. The poles are 3 to 6 inches in diameter and 8 to 10 feet long, and usually 3 to 4 of them are used during a heat.

The metal is under the control of the chief chemist who is responsible for its quality. The analysis reported by the blast furnace chemist is taken for calculating mixtures. Check tests, which occasionally are made, agree closely with the results reported by the producer. Preliminary tests of the metal in the furnace are taken rarely and only when some unusual condition of the heat is noted. However, every heat is analyzed for silicon,

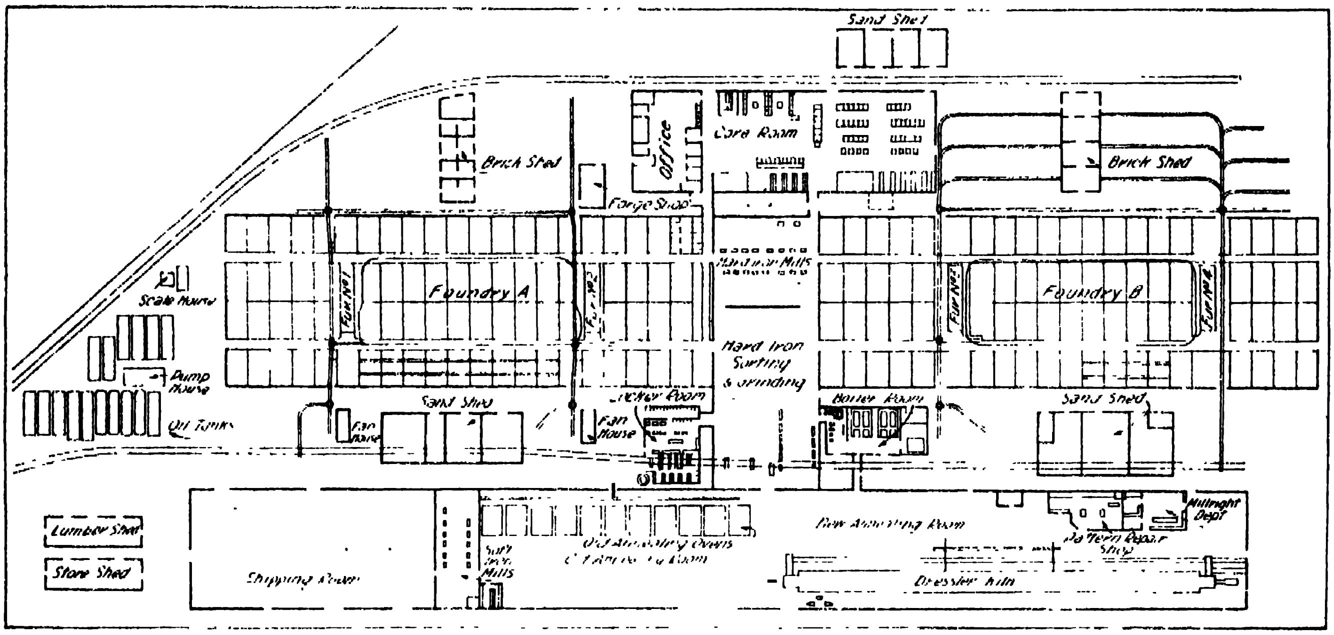


FIG. 1—THE CLEANING ROOMS ARE LOCATED BETWEEN TWO SECTIONS OF THE FOUNDRY AND CASTINGS PASS THROUGH THEM DIRECTLY TO THE ANNEALING DEPARTMENT WHICH IS LOCATED IN THE SAME BUILDING AS THE SOFT CLEANING ROOM

ber. Pig iron and annealed scrap are loaded on wood skips on flat cars, one skip being placed on a car. These cars are pushed into the foundry to the weighing scales on an industrial track. Here the desired amount is either added or thrown off to make the required amount of metal on the skip. A reserve of pig iron is kept in bins near the scales. Sprues and hard scrap are gathered from the foundry floors and brought to a pile near the scales at each furnace.

Fig. 1 also shows the location of the four melting furnaces. These are air furnaces of 25-ton rated capacity, but the average charge is 20 tons. A heat is taken off each furnace just before noon and again the last thing in the afternoon. Metal is melted in the morning heat at the rate of a ton in 16 to 17 minutes, while in the afternoon after the furnace has been heated by the morning melt,

chains hook to two eyes on one side of the wood skip carrying the metal to be charged, and a third chain is attached to the other side by a trip hook. When the skip is in the proper position the hook is tripped and this allows one side of the skip to fall, dropping the metal into the furnace. As may be noted in Fig. 2, a turntable in the track at the corner of the furnace allows the cars carrying the charge to be switched to the end of the furnace where they may be picked up by the crane. This is necessary on the two furnaces first installed but the more recent furnaces have the crane so arranged that it can pick up the cars from the side of the furnace, which is more convenient for charging.

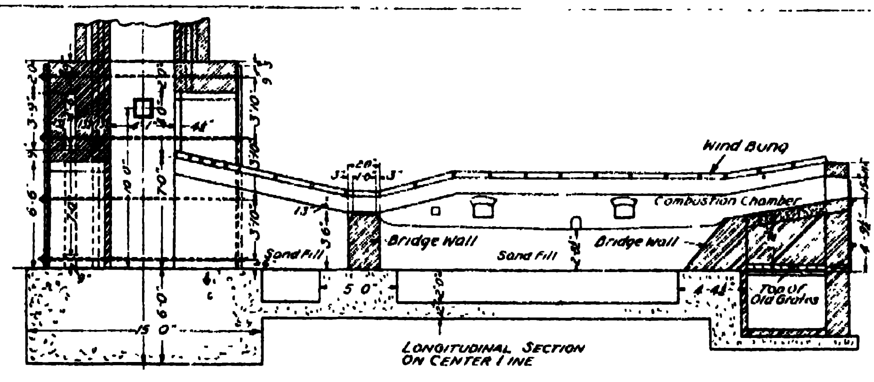
When the metal begins to melt it is stirred with poles of green wood as illustrated in Fig. 2. After the entire charge is melted these poles are im-

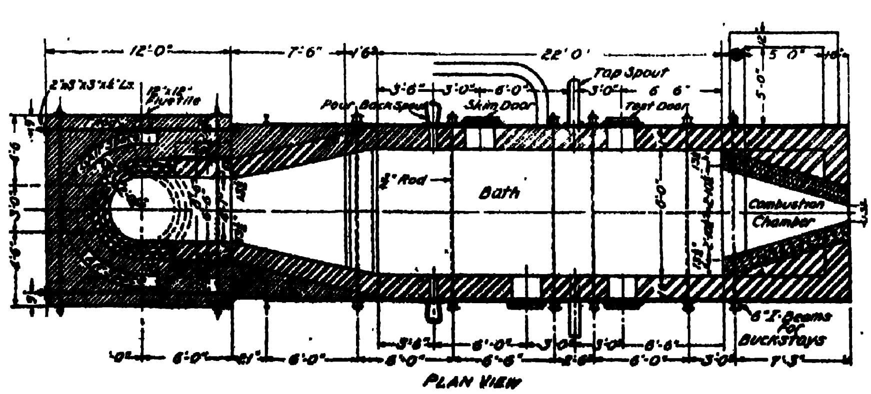
manganese, sulphur and carbon; and phosphorus is determined on the metal from each furnace twice a week. The average heat contains 0.85 to 0.95 per cent silicon, 0.055 to 0.065 per cent sulphur, 0.17 to 0.20 per cent phosphorus, 0.25 to 0.30 per cent manganese, and 2.40 to 2.55 per cent carbon. Some steel and malleable scrap is used in the charge, the amount varying with the quantity of sprue and hard iron scrap used. Under normal conditions the sprue and hard iron scrap is about 48 per cent with 8 to 10 per cent steel and malleable scrap.

Results of the analyses of each heat are secured promptly. The silicon and carbon are determined on the morning heats by 1:30 in the afternoon, and on the afternoon heats by 8:45 the next morning. Sulphur and manganese are reported shortly after the silicon and carbon. Results are

FIG. 2—LONG POLES OF GREEN WOOD ARE USED TO STIR THE BATH—WHEN THESE ARE IMMERSED IN THE METAL VIOLENT BUBBLING IS PRODUCED

reported promptly so that the mixture for the second heat following may be changed if necessary. The charge in each instance is figured and the mixture marked on a board near the scales, car numbers being used to designate the pig iron for the charge. The afternoon charge is marked on the board before 9:30 in the morning and the morning charge is recorded before 2:30 in the afternoon. One of the most difficult steps of the analysis usually is to obtain a suitable sample quickly. This sample is secured at the Saginaw plant by drilling. A test piece 2 x 1 x 3½ inches is cast, and as soon as it is cool it is drilled at slow speed with a flat drill of high speed steel containing 14 per cent tungsten. The chemist hardens the drills by heating them to a sweating heat and quenching in oil. The drill is kept aggitated while it is in the oil bath. As it comes from the quenching bath the drill is quite hard, but it is not tempered and is used as it is quenched. In this condition the drill stands up for four samples which are taken by drilling completely through the 1-inch way of the test piece. Four samples for physical test are poured from the middle of each heat. These are tested on a 50,000-pound testing machine made by the Tinius Olsen Testing Machine Co., Philadelphia. The regular run of metal is made to conform to the requirements of the specification for malleable iron of the American Society for Testing Materials which calls for a tensile strength of 45,000 pounds per square inch and an elongation of not less than 7.5 per cent in 2 inches. The system of pouring will be better understood by referring to the





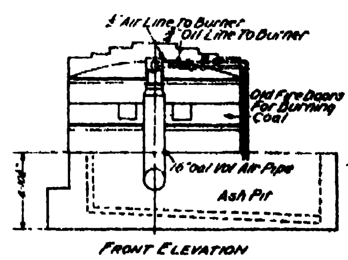
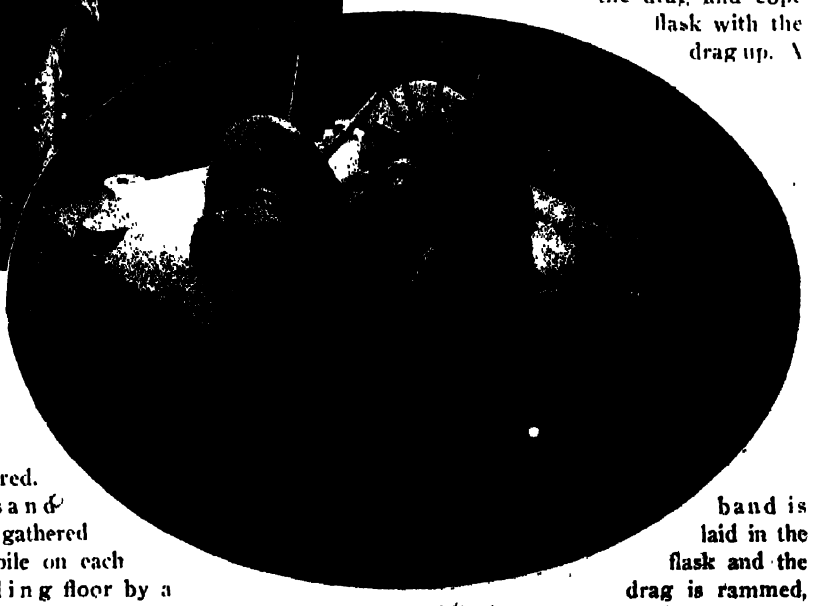


FIG. 3 THE COAL-FIRED FURNACE CHANGED TO BURN OIL FUEL—AIR IS ADMITTED THROUGH THE BURNER AND ALSO AS A TOP BLAST

location of the furnaces in Fig. 1. Here it will be noted that a furnace is located towards the end of each shop. Metal for the molds at the ends of the shop is caught in hand ladles for pouring. These ladles are of 60 and 75-pound capacity. Between the furnaces there is an overhead I-beam which makes a loop up one aisle, in front of the one furnace, down the other aisle and past the second furnace. A portion of this beam may be seen in Fig. 2. Trolleys carrying ladles of 400 pounds capacity are pushed from each furnace along the entire length of one of the aisles. In this way the metal from one furnace is poured only on the floors abutting on one aisle between the furnaces. Metal is poured into hand ladles when the furnace is first tapped so as to have the hand ladles thoroughly heated after which the iron is tapped into the bull ladles. At present the large ladles are heated by wood fires, but an oil burning equipment is being installed.

FIG. 4—A NUMBER OF JOLT, SQUEEZE, STRIPPING MACHINES ARE USED—THESE ARE OPERATED IN PAIRS BY A GANG OF FIVE WORKMEN



Handling the sand after the molds have been poured has been studied out carefully. After the morning heat is off shifters shake out the castings and pile the bottom boards, bands or slip jackets. The molders pull out the castings level the floor, and wet the sand to cool it. Molds made in the afternoon are set on this used sand. The night gang shakes out the castings after the evening heat is poured. The sand then is gathered on a pile on each molding floor by a horse drawn scraper. It then is cut by a machine built by the American Foundry Equipment Co., New York, of which the Saginaw company has three. Cores are picked out of the sand before it is scraped into a pile, but gradually it becomes contaminated by a large proportion of broken cores. Therefore, each pile is riddled occasionally to remove all pieces of cores. Four gyratory riddles made by the Great Western Mfg. Co., Leavenworth, Kans., are used for this purpose. The facing sand also is cut by the machines mentioned. A pile of facing sand ready for mixing is shown near one of the machines in Fig. 10. This sand is made of 40 parts burnt sand to 16 parts of new sand mixed with sea coal in the ratio of 12 of sand to 1 of sea coal.

Three general types of molding machines are used. One is the air squeezer, cope-lifting machine made by the Berkshire Mfg. Co., Cleveland. The second is the jolt, squeeze, strip machine made by the Osborn Mfg. Co., Cleveland. The third is the portable Farwell hand squeezer made by the Adams Co., Dubuque, Iowa. The Berkshire machine is operated by one man while two of the Osborn machines are used for making a mold, one making the cope and the other the drag. A gang of five men, two on each machine and one to set the cores and close the molds, usually are employed on this latter type machine.

A mold of two steering gear housing castings is shown in process on a Berkshire machine in Fig. 8. This requires a flask, 12 x 14 inches, with a 3-inch drag and a 7½-inch cope. As high as 120 molds can be made in a 9-hour day. To make the mold the pattern plate is placed between the drag and cope flask with the drag up. A band is laid in the flask and the drag is rammed, after which a bottom board is placed on top and the whole flask is rolled over. Buttons are then placed on each core print. One of these is illustrated at *A*, Fig. 8. A band is placed in the flask and sand is tucked in the cope around the pattern with the handle of a shovel, then the flask is filled with sand. Both the cope and drag are then squeezed

FIG. 5—DRAGS OF THE MOLD SHOWN IN FIG. 4, WITH THE CORES SET—NOTE THE WEDGE CLAMP AT B FOR FASTENING THE COPE AND DRAG TOGETHER—ONE OF THESE IS SHOWN IN POSITION AT C

by the same operation. After the gate is cut and the buttons are removed from the core prints the cope is lifted and swung back. This is done by means of four lift pins. Two of these are illustrated at *B*, *B*, Fig. 8. The other two may be seen under the flask. These latter have lugs on the top which end in semicircular grooves which fit around circular nobs attached to the flask by brackets. A loose hinge is thus formed on which the cope flask is tilted back until it rests against an upright, *C*, Fig. 8. The next step is to draw the pattern from the drag. The body cores are then set and the flask closed, after which the pin cores are set.

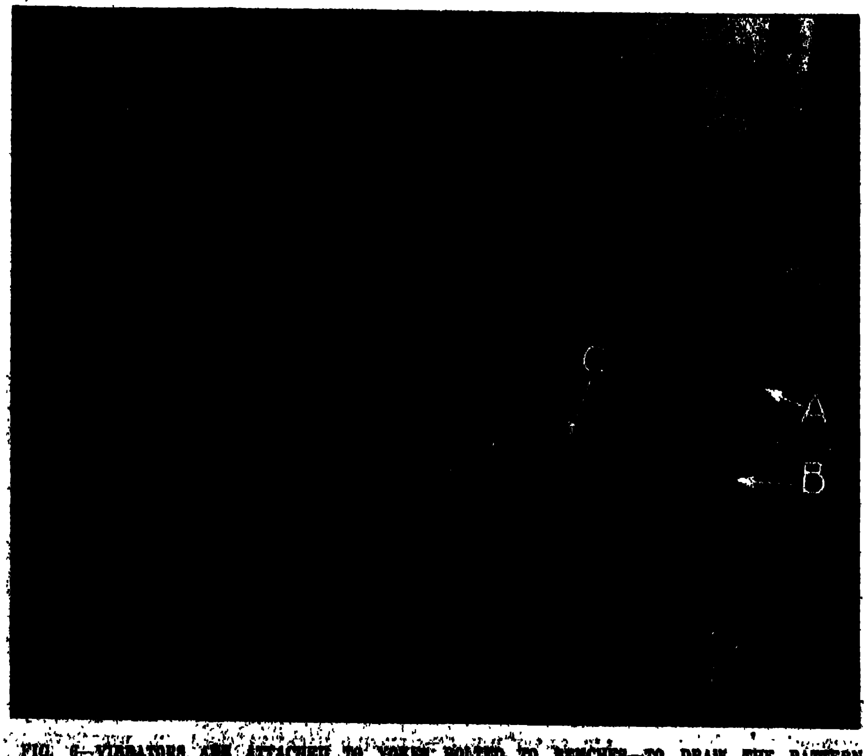


FIG. 6—VIBRATORS ARE ATTACHED TO YOKES BOLTED TO BENCHES—TO DRAW THE PATTERN THE LUG ON THE PLATE IS PRESSED AGAINST THE YOKE

The Osborn machine is illustrated in Fig. 4 operating on a mold for the rear hub of a tractor. The cope machine is shown at the left while the drag pattern with the stripping plate, gate and chills is shown in the insert. A gang of five men make 300 of these molds a day on two machines. Sixty pounds of metal is poured into each mold, which makes 3600 pounds of metal for each member of the molding gang to pour. The company is endeavoring to lessen this work by installing five I-beams over the molding floor to form tracks for a pouring device manufactured by the E. J. Woodison Co., Detroit. This device is equipped with two levers, the one for raising the ladle

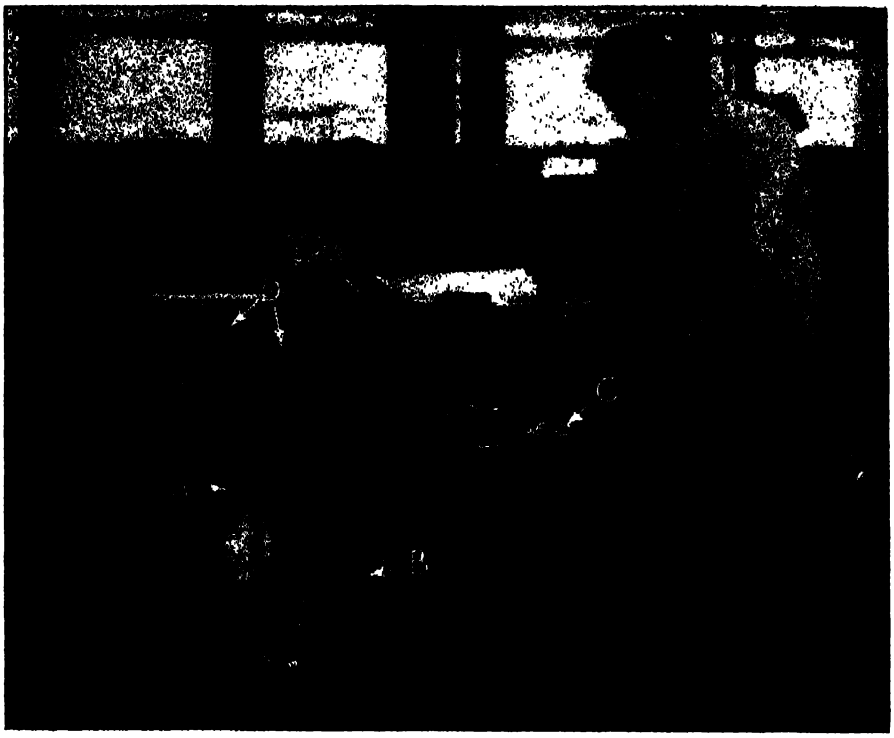


FIG. 7—A MOLDER PUTS UP AS MANY AS 90 MOLDS A DAY WITH THIS EQUIPMENT

and the other for tilting it. If the results of this trial are satisfacory, more floors will be equipped for pouring by this means.

The patterns and flask equipment shown in Fig. 4 were planned for a gray-iron casting, and when it was decided to make the casting of malleable it was found necessary to add the chills. Chilling the iron is regarded as bad practice by the Saginaw company and is avoided where possible. Here the flasks are too small to allow the gate to be changed, otherwise a gate would be attached to the casting at each end instead of at the flanges. At present the gate is in the drag but the section attached to the pattern will be made 1½ inches long, and half of the gate will be placed in the cope. One of the chills is shown in the insert, the other, which is smaller, is placed against the second flange as is indicated by the two nails which may be seen protruding. The chills are quite heavy and the nails are cast in them to hold them securely in the mold. The two halves of the mold are practically identical except that the sprue is in the cope and the gate in the drag. A cope which has been jolt rammed and squeezed is shown in Fig. 4, after the pattern has been drawn through the stripping plate.

The two molders working on each machine place the half of the mold on the floor and a third man sets the body core, the two pin cores and the strainer core. These strainer cores are used on many of the molds to prevent slag and sand entering the casting. The body core is set to the templet held by the molder as shown in Fig. 5. A lug on the gage fits into a depression in the core, which is indicated at *A*. The gray iron flasks used in the Saginaw foundry may be seen in this illustration. The cope is held on the drag by a wedge clamp, one of which may be seen at *B*, standing on a mold. Two of the clamps attached to flasks are shown at *C*, *C*. Another feature of the flasks are the guide pins which are removed after the flask is clamped, so that they may be set in the pin holes of another drag flask.

Some patterns are hand molded on benches from plates. Fig. 7 illustrates a differential gear housing made in this manner. A 12 x 12 flask having a 7-inch drag and an 8-inch cope is used. A molder will put up 85 to 90 of these flasks in a day of nine hours when conditions all are favorable. As each mold requires 28 pounds of metal this necessitates pouring 2400 to 2500 pounds of metal.

The first operation in making this mold is to place the ram-up core on the drag core print. One of these cores may be seen in place at *A*, Fig. 7. This core fits tightly and must be twisted around on the print to loosen it enough so that it will come off easily when the pattern is drawn from the mold. This mold is poured without

FIG. 8—SQUEEZE, COPE LIFTING MACHINES ARE FOUND EFFECTIVE FOR CERTAIN PATTERNS

ALLOYS OF INTEREST TO BRASS FOUNDRYMEN

ALUMINUM ALLOYS USED IN AIRCRAFT

Braces of Zeppelins

	Per Cent
Aluminum	99.07
Zinc	0.13
Iron	0.38
Silicon	0.36
Copper	0.06

This metal was simply commercially pure aluminum, as the zinc, iron, silicon and copper are the usual impurities.

Channel Sections of Zeppelin

	Per Cent
Aluminum	88.68
Zinc	9.10
Iron	0.43
Silicon	0.49
Copper	0.70
Tin	0.15
Manganese	0.43
Nickel	Trace

This alloy consists essentially of commercial aluminum stiffened with zinc, copper and manganese. A somewhat softer alloy was used for the brackets connecting the angles of the various sections of the frame. This alloy follows:

	Per Cent
Aluminum	90.27
Zinc	7.80
Iron	0.45
Silicon	0.37
Copper	0.73
Tin	0.11
Manganese	0.27
Nickel	Trace

As in the other alloys the iron, silicon and the tin also trace of nickel are not added intentionally, but exist as a part of the pure aluminum. The alloy could be successfully imitated as follows:

	Per Cent
Aluminum (Commercially pure)	91.25
30% Manganese Copper	1.00
Zinc	7.75

All the above alloys are soft and ductile, too soft for most casting purposes, but suitable for fabricated shapes such as the channel sections and connecting parts.

ALLOYS OF INTEREST TO BRASS FOUNDRYMEN

Baily's Metal

	Per Cent
Copper	82.00
Tin	13.00
Zinc	5.00

Baily's metal is the alloy used in making the standard yard measure of the United States, also the standard imperial yard of Great Britain, and for 50 copies of this yard for the use of various foreign governments.

Blanched Copper

	Per Cent
Copper	91.00
White arsenic	9.00

This alloy used to be made by arranging copper turnings in alternate layers with the white arsenic and charcoal in a crucible, then fusing the charge. It is better made by the addition of metallic arsenic to molten copper. The alloy is used for clock dials and scales for thermometers and barometers.

Ancient Statuary

An analysis of a statue of Budha supposed to be 3500 years old divulged the following composition:

	Per Cent
Copper	91.502
Iron	7.591
Silver	0.021
Arsenic	0.079
Sulphur	0.510
Gold	0.0005
Insoluble	0.292

The metal was simply a ferrous copper high in sulphur.

Aterite

Aterite is used as an acid-resisting metal and has a large consumption for valves. One analysis of a casting alloy gave the following:

	Per Cent
Copper	65.00
Nickel	9.00
Zinc	20.00
Iron	4.00
Lead	2.00

a slip jacket, steel bands being used. These bands which are standard throughout the shop are made of 1½ x ⅛-inch steel, riveted at the ends. Two bands are placed in the drag flask next to the pattern plate. The drag is then rammed, a bottom board is placed on it and it is rolled over. A chill, *B*, is placed on the cope portion of the pattern before ramming. The chill is set so that the four lugs which secure it in the sand are away from the pattern. One band and the gate stick are placed in the cope. As may be noted in the illustration, the metal flows through the sprue to the strainer gate, *C*, in the drag. It follows through the strainer gate along a runner which extends from the drag into the cope at *D*. This gate terminates in a shrink ball which connects with the casting in the drag portion of the mold.

In Fig. 7 the cope has been lifted from the drag and the molder is ready to set the center core. The lower print is rested in the ram up core which is used to prevent the core print from breaking the side of the mold. The face of the core shown on the left side of the core standing on the drag, rests against the side of the drag mold when in position. An electric vibrator, shown at *E*, is used on this particular plate, although air vibrators are used on part of the plates in the shop. The electric vibrators are said to be somewhat heavier and more cumbersome than the air vibrators, but have the advantage of lower operating cost and less expensive upkeep. The disadvantage of the weight of the electric vibrator is overcome by the arrangement shown in Fig. 6. Here the vibrator, *A*, is attached to a yoke made from bar steel. This yoke is bolted firmly to the molding bench. To operate the vibrator, the extension on the pattern plate, shown at *C*, is pressed against the yoke and the cope lifted. By having the vibrator attached to the yoke trouble with the connection cord is eliminated. In case pattern plates are received which do not have the extension, a rib is riveted to the plate. A noticeable feature of the plate in the illustration is the large lugs. These are made extra heavy to eliminate breakage.

The core room is equipped for making cores rapidly and economically. Two sand mixers built by the Blystone Mfg. Co., Cambridge Springs, Pa., and two rosin mills manufactured by the W. W. Sly Mfg. Co., Cleveland, prepare the sand for the coremakers. Coremaking machines have been installed to meet the needs of the different shaped cores made. The installation consists of two machines built by William Demmler & Bros., Kewanee, Ill., two rollover machines made by the International Molding Machine Co., Chicago, and four machines supplied by the E. J. Woodison Co., Detroit. Three of these latter machines are used mainly for making cores with long straight draw, but the fourth is adapted to a somewhat different purpose. It makes the

FIG. 9 A COUNTERWEIGHTED MACHINE ENABLES GIRLS TO MAKE HEAVY CORES—PRACTICALLY NO EFFORT IS REQUIRED TO RAISE THE LARGE CORE BOX

large body core for the tractor hub mold which is illustrated in Fig. 5. This core which is 14½ inches long and 4½ inches in diameter at its largest cross section is too heavy for a girl to handle. The machine which is counterweighted to help raise the core box is an aid in handling the box when making this core. The counterweight is attached to the machine by the flexible steel cable, which extends over a pulley. The core box is clamped together and set on the bench for ramming as indicated in Fig. 9, insert. When the sand is rammed and the stiffening wires are in place, the core girl raises the box slightly and turns it, laying it on the bench. One-half of the core box, shown below, is then removed and the dryer plate substituted. The core girl next raises the core in one-half the box with the dryer, and turns it, placing it on the bench with the dryer down. When the dryer rests on the bench the other half of the core box is raised and the drier with the core in it is transferred to a rack which is placed near the operator. In all these movements practically no manual lifting of the sand and corebox is required as the arm is moved up and down the standard to which it is attached, by the counterweight. Before the machine was installed a man made these cores and his best record was 175 cores a day. The girl operator has made as many as 330 cores in a day and her daily average is 300 cores. Girls have proved efficient for many operations in the core room and compose more than two-thirds of the core room force. Cores are handled to and from the ovens on racks carried by an electric lift truck made by the Elwell-Parker Electric Co., Cleveland. The eight ovens are coke fired and are arranged in two batteries of four each. The temperature of the ovens is recorded by thermometers, one of which is attached to each oven. The efficiency of the molding methods of the Saginaw foundry is demonstrated by the average April production of each molder which totaled 1015 pounds of good castings per 9-hour day. The average weight of the castings was 3.13 pounds. The production system by which the operation of the foundry is regulated will be described in a succeeding article. After castings are poured and separated on piles they are carried to the hard iron tumbling room in hand trucks made by the Howe Chain Co., Muskegon, Mich. They also are hauled in tractors supplied by the Clark Tructractor Co., Chicago, six of which are in operation about the plant. Five of these have dump bodies and the other has a platform body. This latter tractor is used largely in the annealing room for pushing about the cars which handle the castings through the tunnel kiln. The others are used for hauling refuse sand and slag to the dump, transferring castings to the hard room and from there to the annealing department and on to the shipping division.

The hard iron tumbling room is equipped with 16 mills. These barrels

FIG. 10—MACHINES ARE EMPLOYED FOR CUTTING FACING SAND AS WELL AS PREPARING THE FLOORS FOR THE MOLDER WHEN HE COMES IN THE MORNING—THE PILE TO THE REAR IS READY FOR THE MACHINE AND WILL BE CUT AND THROWN ON THE PILE TO THE RIGHT

are raised off the ground high enough so that hand trucks may be shoved under them for receiving the castings when they are dumped from the barrels. Castings are taken from the hard iron tumbling barrels to the sorting department and from there to the grinders. The proximity of these departments is shown in Fig 1.

In the sorting department the castings are separated in piles according to whether they are to be packed in the annealing pots by hand or shovelled in. The castings to be shovelled into the annealing pots again are divided into the medium and heavy size and into the quite small castings which are shovelled into the pot to fill crevices left between the larger castings. Details of the annealing operation will be described in a later article of this series.

The heating and ventilating systems and the plan for providing cold drinking water at the Saginaw plant, are unique. Four boilers have been installed, laid out on the power house principle so that one or as many as are needed may be used. These boilers furnish steam for a 1200-foot, 2-stage air compressor, as well as for the heating system. Waste steam from the compressor is also taken into the heating system.

Heat is supplied by blowing air over steam coils. These coils are hung in compartments on girders in the center of each foundry. Pipes extend from the heaters to each aisle where the pipes branch. These main pipes then follow along the entire length of each aisle, where short leads extend from the main feed pipes at intervals. These leads are turned downward at the ends and are directed toward the center of the foundry. Other longer pipes extend from the feed pipe to near the walls of the foundry. A Pond roof covers the entire length of the foundry at the center immediately over the furnaces and serves to carry away the hot air coming from them thus forming a draft to take off the smoke from the molds after they are poured. In the summer the foundry becomes heated after the metal is poured, but the pipes of the heating system are used to blow air from the outside into the foundry which is soon cleared of smoke and made preceptibly cooled.

The ventilating system in the core room may be understood from Fig. 11. The monitor roof at the left is directly over the ovens and above that portion of the floor where the racks of hot cores are placed after being taken from the ovens. This heat creates a draft pulling air, in the summer, from the windows shown to the extreme right. In the winter hot air is supplied through ducts arranged along the side wall at the right. This hot air serves to carry off the fumes through ventilators in the monitor roof.

The drinking water system includes a still which supplied distilled water to a refrigerating machine, from where it is continually circulated through the foundry and always is cold at the drinking fountains.

Electric power is secured from the

FIG. 11—THE CORE ROOM IS VENTILATED THROUGH THE MONITOR WHICH COVERS THE OVENS AND THAT PORTION OF THE FLOOR WHERE HOT CORES ARE SET—HOT AIR IS BLOWN FROM DUCTS IN THE SIDE WALL IN WINTER

local electric company which supplies current at 5000 volts. This is stepped down to 440 volts for the crane and other motors, and to 220 volts for the lights which are operated on a three wire system, giving 110 volts for each light. The transformers and switchboard for controlling the current are located in the boiler house as is also ... compressor. This compressor is used on Sundays and holidays for supplying what little compressed air is necessary for the burners and other miscellaneous purposes. Being motor-driven, it is independent of the operation of the boilers.

Other aids to efficient management and welfare work are the clock system, a large and well appointed cafeteria and a first aid room with a nurse in constant attendance during working hours. The entire clock system is controlled electrically by a master clock so that every clock in the plant has exactly the same time; the whistle clock has the same time as the wall clocks used to tell the time to the employes, and the program clocks on which time clerks stamp the time for a job.

Foundrymen Fear Serious Sand Shortage

WINTER, with its attendant transportation and handling difficulties, threatens to find foundries of the country unsupplied with the customary reserve stocks of core, molding and sandblast sand. At no time since the start of the war has the situation been so serious. A canvas of the leading sand producers of the country shows that the present time, when shipments usually are going forward in steady volume, less than 25 per cent of the needed supply of cars is available.

When the interstate commerce commission announced its decision to restrict the use of open-top cars to the shipment of coal, the full effect upon sand shipment was not realized. It soon was apparent, that in common with other commodities, such as coke, pig iron, rolled steel, building materials, etc., sand was practically ruled off the railroads. A later modification of the order permitting the shipment of materials other than coal in open cars with sides up to 36 inches promised some relief, but in effect has favored merchandise and finished commodities rather than vitally needed sand and coke. At the the same time, the original order was continued to about Aug. 20.

A specific instance will serve to indicate the state of the need in some of the leading centers. In Cleveland, a survey of 35 leading foundries showed that 2064 carloads of core and molding sand will be required for the winter of 1920. Approximating the needs of some others not reporting, one of which will use more than 400 cars, a total estimated consumption of 3000 cars is shown for the fall and winter. Of those interviewed, only one had three months supply, two had a quantity sufficient for two months, 10 had stored enough for one month and the remainder faced a sand famine in from one to three weeks.

Some more optimistic among the foundries listed in this inquiry expressed the opinion that with the present concentration on coal shipments, sand would have its turn later and would be obtained without difficulty in the early winter. However, to those who have had experience with handling sand from open cars in winter, this prospect holds little comfort. One large foundry stated that the additional expense of hauling its sand through the winter as a result of not having accumulated a reserve had cost over $80,000. These conditions obtain in a district less than 100 miles from some of the largest sand producing acres in the country.

In the east, the shipping conditions are particularly difficult. The large producing plants are in the Albany and Hudson river sections in New York and the Perth Amboy, Mt. Holly and South Jersey districts in New Jersey. It is stated that for days at a time no a single car is available at some of the plants, and where four or five cars are needed every day, the average is less than a car a day. All local consignments are banned, except into the soft coal regions, which usually are not foundry districts. A ruling in the South Jersey district permitting a shipper 15 per cent of the capacity of his siding, obviously does not guarantee delivery of cars to meet even this minimum allotment. The total tonnage shipped since Jan. 1 is less than 50 per cent of that handled last year up to the same time. Producers report orders upon which they hesitate even to quote fearing still further restrictions on transportation.

A central Ohio sand company states that it is granted only about 10 per cent of the shipping permits for which it applies. Previous to July 1 an average of 60 per cent of the cars requested were available, and the total tonnage shipped the first half of the year was about the same percentage of the total orders received. This company estimates that on the present basis of shipment its customers will lack approximately 900 cars of sand during the coming winter.

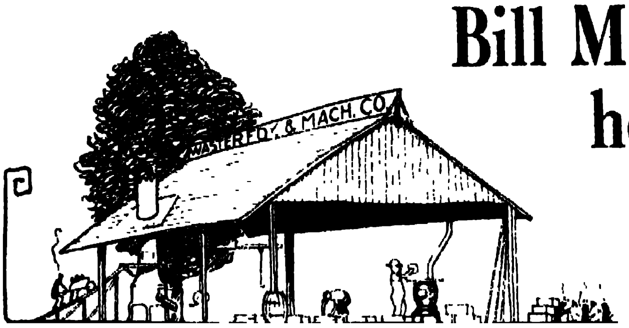
Another company which should have shipped 875 to 900 cars from one of its properties, up to July 20 had been able to secure only 207 cars. This same company has nearly 700 cars booked for shipment prior to Dec. 15, with new orders coming in steadily. This company at present estimates that even with a continuation of the same rate of car supply, it will be able to load only about 400 cars before the season is over. Based upon the usual fall rush of sand orders, the shortage will be from 500 to 750 cars by the middle of December.

An Illinois company which ships during the entire year obtained only 23.7 per cent of its car requirements during June, and the first half deliveries were far below normal. This company estimates that it will be unable to supply its customers' requirements for the remainder of the year and that its lack in cars will result in a 25 per cent curtailment.

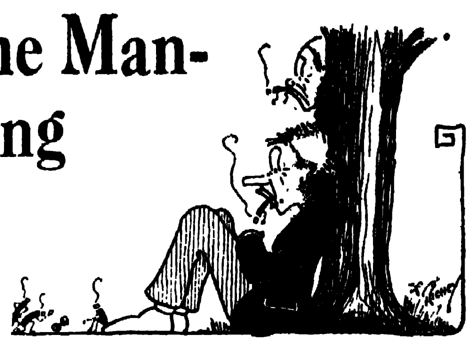
The southern producers are slightly more fortunate, as the car situation has been easier throughout the South. However, embargoes against northern territory act as a barrier to the hope of northern foundrymen securing needed sand from such sources.

With the severe shortage of all sorts of rolling stock, little choice in cars is offered distributors. Molding sand producers who desire open top cars by reason of the class of loading equipment which they employ are accepting box cars without question, and some even are putting in box siding in cattle cars to serve their customers. Silica-sand manufacturers, after digging, grinding, washing, screening and drying their product which is intended for sandblast work dislike to use open top equipment, but at present seem able to obtain a greater number of cars of this class. The arrival of sandblast sand in a wet state, or contaminated with dirt and cinders often is a source of expense and inconvenience to users.

A high-speed steel used in England contains substantially the following: Uranium, 0.7 per cent; cobalt, 4.5 per cent; tungsten, 13.5 per cent; vanadium, 1.5 per cent; chromium, 3.5 per cent, and carbon, 0.7 per cent. The addition of cobalt and uranium, it is claimed, results in an increased cutting efficiency.



Bill Makes Some Man-hole Rigging



BY PAT DWYER

I WAS telling Bill the other day about a queer little shop I happened to drift into recently and about the old fashioned rigging they were using in an old fashioned way to make some of the work.

"It simply is wonderful," said he, "the way in which a foundry will cling to antiquated methods and keep on using patterns that should have been relegated to the scrap heap years before. Frequently the patterns or rigging were designed either by amateurs or by some person who was unfamiliar with the job and was just feeling his way. If the pattern works and it is possible to get castings from it, the chances are in favor of it remaining a fixture in the place until the man who got it up dies, resigns or gets fired.

"Perhaps I should qualify that statement and make due allowance for the popular foundry tradition that molders never die; but there is certainly nothing vague, intangible or traditionary about the fact that they sometimes get fired and there is still less doubt of the fact that they resign 'free and frequent.' Those Arabians that Longfellow sings of so tunefully, who fold up their tent and disappear, have nothing on the migratory birds who learn their trade in a foundry and who are inoculated with the virus of *wanderitis* long before they have finished serving their time."

I interrupted him here to point out, calmly I hope and with a fitting sense of the proprieties, that I saw nothing strange in the fact that a man should wander around from place to place in a physical sense; but when his mind commenced wandering, I thought something should be done about it.

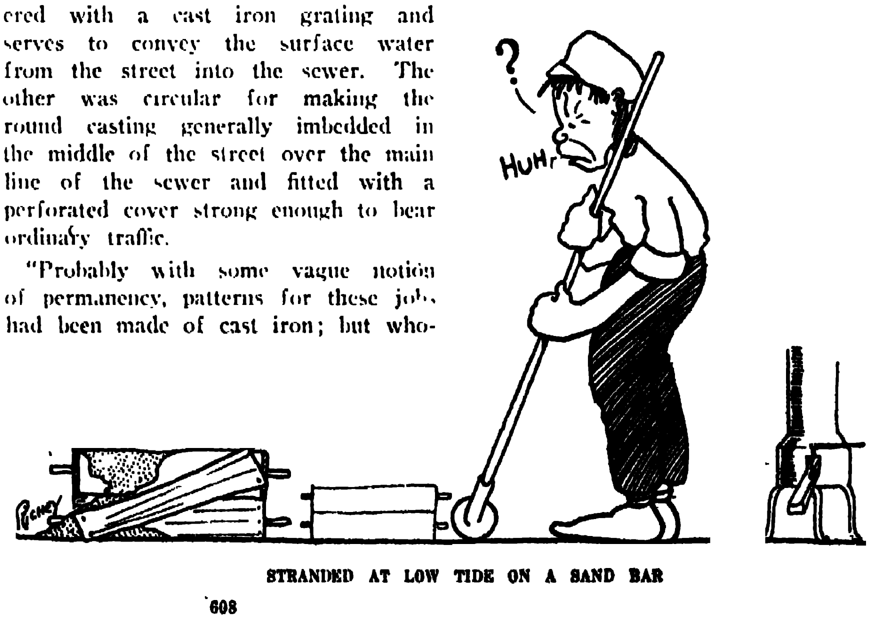
"You began by talking about antiquated patterns," I said, "and here you are now talking about Arabians and I should not at all be surprised if you switched from that and launched out into a panegyric of the 'Blooming, Balmy Babylonian Order of Bally Blighters.' Stick to one thing and get it off your mind."

"Don't be in such a hurry," said Bill. "You remind me of a young fellow making his first mold. He is so anxious to draw the pattern and see what the mold looks like that he forgets to put clamps on the drag before rolling it over. The board slips, some of the sand falls out and the pattern looks like a ship that has been stranded at low tide on a sand bar. That preliminary passage with which I favored you has a direct bearing on what I intended to say. It was neither superflous nor irrevelant, but if you find any difficulty in following me I shall draw you up a chart and indicate by suitable references the proper places to applaud.

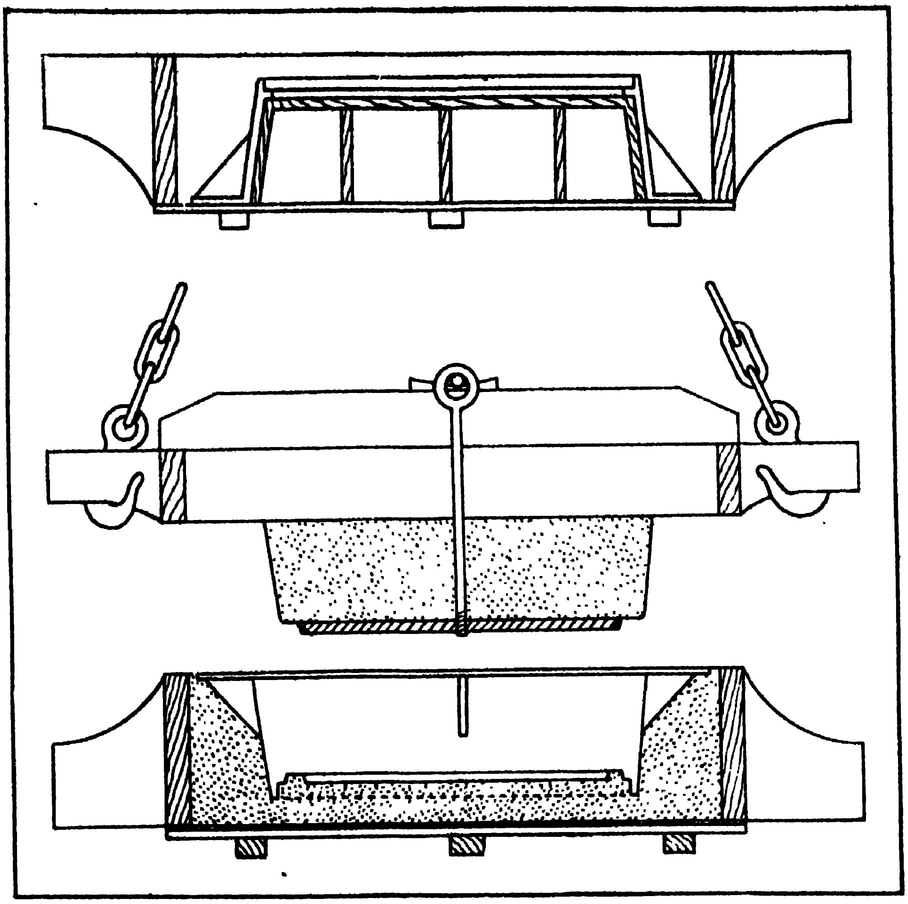
"I worked in a place one time where they made city work. You know what I mean, water works and sewer castings and all that kind of thing. The man who preceded me had graduated from a little shop where the principal product was stove repairs and plow points. Some of the patterns and rigging he got up were wonderful. Yes, sir! Wonderful is the word. A sight of any of these patterns would force the admission that one of the seven wonders of the world was how some people secured positions as foundry foremen. I don't want to impose too great a strain on your credulity so I'll just tell you about the patterns which were for castings known as *catch basins* and *man-holes*. One was square and was used to make the casting usually seen at the intersection of gutters at street corners. It is covered with a cast iron grating and serves to convey the surface water from the street into the sewer. The other was circular for making the round casting generally imbedded in the middle of the street over the main line of the sewer and fitted with a perforated cover strong enough to bear ordinary traffic.

"Probably with some vague notion of permanency, patterns for these jobs had been made of cast iron; but whoever made them evidently was in a hurry. Whoever finished them and gave them a coat of paint was in even a greater hurry for he hit only the high spots. The patterns would not lift and they would not draw and they were so heavy that one man could not handle them alone. The square frame was molded with the exterior flange up. The drag was filled with sand, rammed and rolled over and then a tedious parting about 6 inches wide had to be made all around the interior and down as far as the lip which supports the cover when the casting is in use. In ramming the cope this deep pocket had to be provided with soldiers and gaggers and on account of the rough pattern a considerable amount of patching always was necessary after the cope had been lifted. The pattern did not draw well and consequently the mold was torn each time the pattern was used. There was no provision made for inserting lifting screws. Two men were required to draw the pattern. They dug two holes each on opposite sides of the pattern and grasped the pattern with their fingers.

"The grating cover was drawn in the same way. In addition to mending the places where the hands had grasped the pattern, it also became necessary to build up about half of the pockets which always were disturbed and broken during the drawing operation. A man who



STRANDED AT LOW TIDE ON A SAND BAR



LONGITUDINAL VIEWS OF MAN-HOLE FRAME MOLD—UPPER, PATTERN, FOLLOW BOARD AND FLASK ARRANGED FOR RAMMING THE DRAG—MIDDLE, COPE LIFTED OFF—LOWER, DRAG WITH PATTERN REMOVED READY FOR CLOSING

made three of these castings a day was *going some.*

"The pattern for the round man-hole frame was not a bad casting. It possessed a few minor defects which prevented it from being classed in the preferred A. 1 list as a pattern. The man who made it depended more on *faith* than on *good works.* He did not close his cope fair and as a result one side of the vertical wall was thicker than the other. His clamps must have been loose on one side while pouring the casting for the flat flange around the outside was ½-inch thick on one side and only about ¼-inch thick on the opposite side. There was a cold shut on the thin flange side and another gap nearby where a piece had been knocked off by accident. However, its principal defect lay, not in any of these things, bad as they were from an efficiency viewpoint; but in the design. The vertical wall was over an inch thick,—out of all proportion to the thickness of the flange, and as a result the casting was sure to crack while cooling, unless it was poured from nice soft, strong iron and was turned over and stripped before it cooled.

"The cover pattern for the man hole was the bright particular gem of the collection. It was about 2 feet in diameter, convex, with a reinforcing rib about 3 inches from the circumference and two ribs at right angles all the way across, on the concave side. The convex side carried a number of small, square, flat bosses equally spaced about 6 inches apart. Tapered ⅞-inch dry sand cores were set in the drag and touched the cope in the center of these bosses when the mold was closed. The ring and ribs were loose and the rough, cored holes were in the pattern. The mold was rammed in the usual way and the cope lifted off. The sand was dug out of the holes in the pattern with a lifter after which a punch stick was used to make the prints in the drag. A couple of gate pins then would be driven into opposite holes in the pattern and two men would draw it out of the sand. The cores would be set and the cope tried off before drawing the ring and the ribs. Taking it by and large I don't think any man could have invented a more awkward outfit.

"I put up with it for a short time and then I had some wooden patterns, close fitting flasks and follow boards made, which so simplified the job that practically no skill was required to make the castings. For instance on the cover which formerly required a skilled molder a full day to make three castings, because most of his time was taken up in patching the molds, an ordinary laborer had no trouble in making 10 molds a day with the new *rigging.* All he had to do was ram the mold, draw the pattern and close the mold again. This was in an ordinary jobbing shop which was not equipped with molding machines and where all the ramming was done by hand.

"The four new patterns were strong and substantial, and they were designed to last indefinitely. Rapping and draw plates were attached to the two covers and lifting straps extending to and hooked under the bottom of the side walls were checked in and screwed to the two frames. Each of

MANY ARE CALLED BUT ONLY ONE IS CHOSEN

the patterns was generously drafted and required little or no rapping before drawing out of the sand.

"After the holes in the round cover had been bored in the usual way with a brace and bit they were given the correct shape and size with a tapered iron heated red hot. Each of the patterns was given several coats of black shellac and believe me after that we got castings that were *castings* and not queer looking things that looked as if they had been dug out of an iron mine with Robinson Crusoe's wooden hoe.

"The thickness of the vertical walls in the square and round frame patterns was reduced to ¾-inch tapering to ⅝ and as a result we had no more cracked castings even when they were poured from an all-scrap charge. By an all-scrap charge I don't mean a charge that has been carefully dosed with ferrosilicon and ferromanganese but a charge made up of ordinary foundry scrap.

"The patterns were molded in the same position as formerly. A round plate attached to a long eye bolt suspended from a bar resting on two strong backs across the cope was used to carry the body of sand forming the inside of the round frame. The cope with the lifting plate attached was lifted by the crane and held while the pattern was being taken out of the drag. It was then lowered back into place. There was never any finishing necessary either on cope or drag. A set gate with two branches was rammed with the pattern in one corner of the flask so that it was not necessary even to cut a gate.

"The inside of the square frame also was lifted out, but not as part of the cope. These frames were made on the side floor which had no crane and to make the job as light as possible a flat cope was used and the sand forming the inside of the mold lifted out separately on a flat plate provided with four loops for that purpose. Two men lifted the cope and set it on an empty flask; then they attached two eye hooks each to the loops and after placing two pieces of pipe in the eyes they lifted the body of sand out of the pattern and set it on a stand alongside for a minute while they drew the pattern. It was then returned to its place and the cope closed down. This pattern also was provided with a set gate on the side which was without a flange.

"Yes, indeed," said he in conclusion, "this old, antiquated and amateur rigging is bad medicine; but it is remarkable how many shops there are which cling to things of that nature. If you ask my opinion, the reason frequently is because the manager is not a practical man and cannot realize the benefit to be derived from modern, up-to-date, labor saving devices, patterns and equipment. He will fight to the last ditch to save or make a penny on any one of his financial transactions; but he does not know what economies can be effected by spending a few dollars on good patterns. He is willing to spend any amount of money on advertising; but he thinks if he gets a foreman for a small salary he is getting a bargain. Well, so he is, there are always two parties to a bargain, one gains and one loses."

"The same applies to presidential candidates, don't it, Bill?" said I.

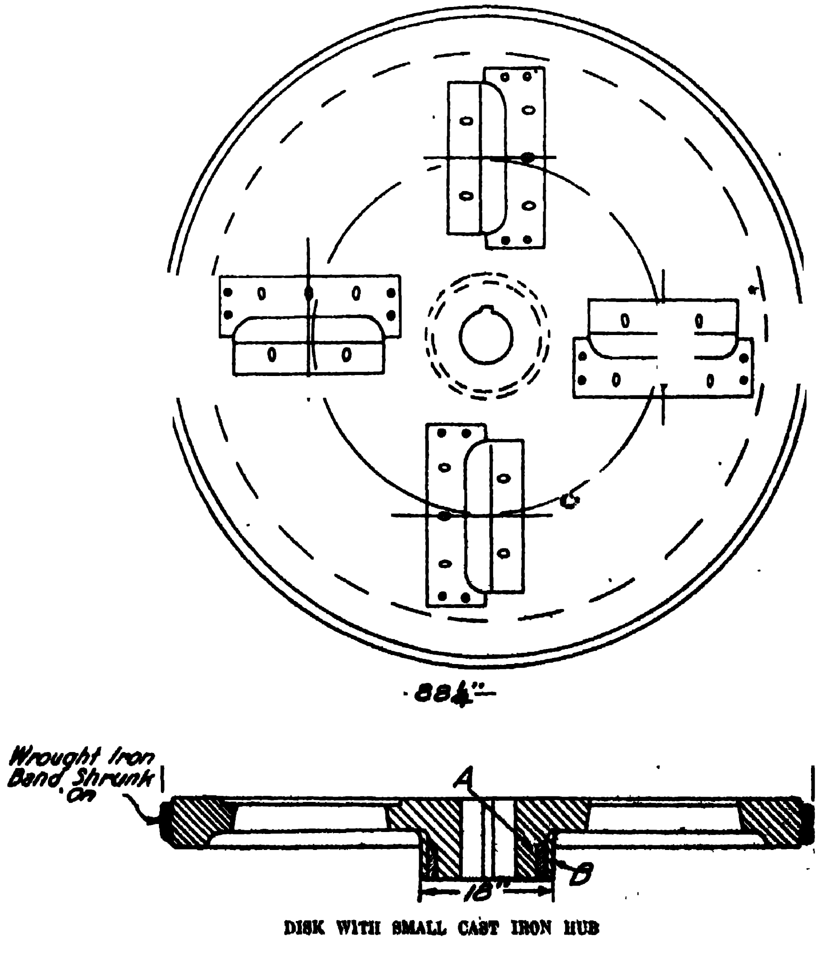
Increasing Hub Diameter

Question. We have always made the disks shown in the illustration with a comparatively small cast iron hub. It is strengthened afterward by shrinking on a cast steel band fitted as shown at *A*. The 45-degree is not a good one as the band shrinks axially while cooling and leaves an opening of about 0.01 of an inch. The reason for putting this band on appears to have been that there was some difficulty in casting a heavy hub free from shrink holes. The design has been criticised and we have been told that the disk will be stronger if the hub is made larger and solid without any band as shown at *B*. At present the castings are left in the pit without being uncovered for about 48 hours. Do you think there would be any danger of spongy hubs if they were made 18 inches in diameter? Would there be any danger of shrinkage strains in the web or the disk on account of the greater mass of iron in the hub? If so what method would you recommend for remedying this difficulty?

Answer: The desired change is recommended. Increasing the diameter of the hub by 3 inches will give a stronger disk than the present small hub with the cast steel band. It also will eliminate the costly operations of machining a seat on the hub, machining the inside surface and top edge of the band and shrinking it on.

There is a certain amount of internal strain in all circular webbed castings. The strain increases in intensity according to the relative thickness of the metal in the different sections. In this particular casting there is no abnormal disproportion and what little strain develops can be lessened by stripping the hub after the casting has set and digging out the center core. This will allow the hub to cool in the same length of time as the web.

There should be no difficulty in preventing the hub from shrinking. Place a 6-inch riser on it, tapered down to 4



DISK WITH SMALL CAST IRON HUB

inches where it joins the hub and feed it with a ½-inch rod. See that the riser is supplied with hot iron at frequent intervals until the solidifying iron in the casting forces the rod out of the hole.

It does not harm the castings to leave them in the sand for 48 hours after they are cast but 12 hours is long enough.

Small Drawings of Shop Buildings

By George W. Childs

The works engineer in a large steel plant had small drawings and blueprints made up of each building unit in the works. These drawings are all of standard size, 8½ x 11 inches. They have served a very useful purpose at the works at which they are used and it is thought that every industrial plant would be benefited considerably in preparing drawings of a similar nature. The drawing exhibit only the general details and dimensions of the building. In the plant mentioned there are 15 separate and distinct units so that it was necessary to make as many drawings.

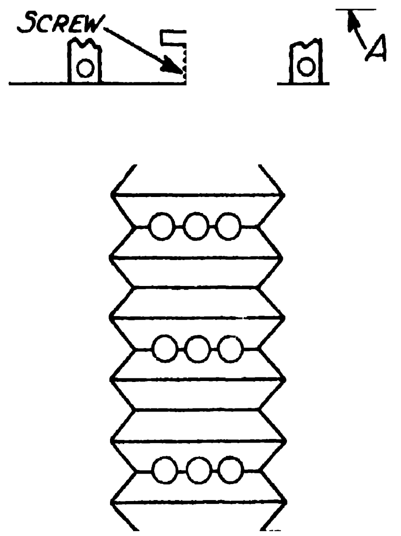
Like in a great many other large industrial plants there are also the usual large cumbersome working drawings of each building or unit, which cause no end of time and trouble when being taken out and put back into the drawing files. Again, such drawings are too expensive and important to be continually removed and placed back in the files. The tracings as a rule are generally handled roughly especially if allowed to get in the hands of those who were not trained in some good drafting room.

The small drawings have about all the information necessary shown on them and by their use the wear and deterioration of large tracings and blueprints which cost many times as much as the smaller ones is saved. Complete bound volumes or sets of the small-sized blueprints should be on file, not only in the drawing office, but also in the general manager's, master mechanic's and other important offices in the plant. The drawings are frequently referred to and if bound and widely distributed they will be ready for instant use and will save the delay and confusion which is often caused by inability to locate a drawing when needed.

Multiple Clamping Device

By Charles C. Lee

Sometimes castings which have been molded on their sides are poured on end. In the case of small flasks such as are used in brass foundries, it requires considerable time to clamp a large number of flasks individually and turn them on their sides for pouring. It also means that two boards must be provided for each flask, one on the top and one on the bottom. With the device shown in the accompanying illustration it becomes possible to clamp six or eight flasks at one time and only use two boards. The flasks are clamped while in an upright position and then laid over on one side for pouring. As may be seen in the illustration the device consists of two long clamps, provided with toes at one end and rows of holes at the other. A yoke A with a threaded hole and a bolt in the center is dropped down close to the surface of the upper board. Two bolts, one in each clamp are used to hold the yoke in place. Pressure is applied by turning the screw B.



THE YOKE MAY BE ADJUSTED TO VARYING HEIGHTS BY SHIFTING THE PINS IN THE CLAMPS

Round Plates Warp During Cooling Process

By M. E. Duggan

Flat round disks or plates made of cast iron usually will be found hollow or dished on the top side when taken out of the mold. This is because the top and bottom faces of the casting together with the outside edge becomes set first through contact with the mold leaving the center soft and the last part to cool off. When the center does shrink, a severe strain is imposed on the rim which has already reached its limit. In extreme cases this causes the rim to open up, the crack frequently extending to the center.

If the cope is comparatively thin the heat will radiate rapidly through it causing the top side of the casting to cool off and contract first, thereby shortening or dishing that side. The bottom side cools off and attempts to contract later but the top is too rigid by that time and the plate remains in the distored condition, with the bottom side in a state of tension. If the metal thickness is not evenly distributed throughout the pattern every curved portion will be exaggerated in cooling.

If the pattern is perfectly true; if cope and drag are the same thickness and both rammed evenly; and if the casting is not stripped too early; there is no reason why the casting should not come straight. The strain is distributed evenly in the same plane and balanced. However, if the plate has a molding or strip around the outside edge on the lower side, it will have a tendency to buckle up in the center when cooling. This is because the top face, bottom face and rim cool in the order indicated. The rim cools last and finding less resistance on the bottom side to contraction travels in that direction. The combined contraction of the rim and the bottom face overcome the resistance offered by the top face with the result that it is forced up in the center.

New Sand Beds Opened

The Cross-Glave Co., Inc., 402 Omondaga Bank building, Syracuse, N. Y., recently has opened new beds of molding sand located in New York state within a few miles of Syracuse. The company now is making local deliveries and plans soon to extend its shipments to outside foundries.

Purchases Another Plant

The Worthington Pump and Machinery Corp., New York, has purchased the Platt Iron Works, Dayton, O. Oil mill machinery, hydraulic turbines and water wheels, feed water heaters and high pressure air compressors will be manufactured at this plant.

A bearing metal patented by W. H. Kelly is made of copper and lead. It is claimed that the lead is held in solution in the copper by purifying it with hydrogen and oxygen while it is in the molten state. This purified lead is then mixed with pure molten copper in the required proportions.

Electrical Melting of Alloys-XI

Essential Points Which Influence Efficiency of Operations Require the Installation of Electric Furnaces Under Expert Supervision — Refractories Are Discussed

BY H. W. GILLETT

CERTAIN points in the installation of electric brass furnaces require the attention of someone with a knowledge of electrical engineering, as applied to electric furnaces, rather greater than that possessed by the ordinary firm of electrical contractors. Therefore, the advice of either the furnace maker or the central station always should be taken, rather than that of a plant electrician or contractor. The need for expert advice centers upon the fact that carrying alternating currents of a couple of thousand amperes is different from that of handling the much smaller currents of the ordinary power or lighting circuit.

Compared to the problems* involved in carrying currents of 20,000 amperes often required by large ferroalloy or iron smelting furnaces, or even those of 5000 to 10,000 amperes, as taken by large steel melting furnaces, the problems, even with the largest brass furnaces, are fairly simple.

For example, in one of the Swedish iron smelting furnaces, taking 3000 kilowatts, the losses between the transformers and the furnace were 475 kilowatts with one method of running the leads from transformers to furnace, while with another the losses were cut to 285 kilowatts, the power factor being at the same time brought up from 70 to 90. In addition to the actual saving of energy, the change made 3500 kilovolt-amperes of transformer capacity capable of sending more energy to the furnace than 4500 kilovolt-amperes capacity did previously.

In another 4000 kilowatt furnace, 490 kilowatts were lost between transformers and electrodes, 165 kilowatts in the leads themselves and 315 kilowatts in the structural iron work near those leads. Power used in heating leads or nearby iron work never gets into the furnace, but it has to be paid for just the same.

In an Heroult steel furnace of about 1300 kilowatts, it was found that the voltage drop in one of the leads passing near some structural steel was over three times the drop in another similar lead more remote from the steel work. The leads originally were made up of busbars held apart to allow ventilation and radiation of heat, by copper spacers, which made the whole lead essentially one big conductor instead of several separate conductors in parallel. Merely by taking out the copper spacers and putting in insulating spacers, the voltage drop was decreased, the furnace was capable of doing more work, and the furnace made its heats faster and at a lower power consumption.

All this peculiar behavior of leads carrying heavy currents is due to alternating current traveling in waves, first in one direction and then in the other. The more often the waves travel, the greater the complications.

Transmit Alternating Current

With direct current, such as in storage batteries, electroplating, etc., the current travels steadily in one direction. However, direct current cannot be transformed from one voltage to another and hence must be generated at the voltage at which it is to be used. Therefore, it must be transmitted at low voltages and high currents. Alternating current on the other hand can be generated at many thousands of volts and transmitted over long distances over tiny wires at low currents. Since the heating of a conductor depends on the current and not the voltage, and increases as the square of the current, this high voltage transmission at low currents means that there is a huge saving due both to the diminution of energy losses and the decreased cross section of conductor required.

When the high voltage alternating current has been brought to the point where the power is used, it is merely run through a transformer which can change it to the lower voltage wanted, at a correspondingly higher current. For this reason all electric furnaces that need merely heat, and not the electrolytic action of the direct current, use alternating current. With direct current, the same number of amperes of current passed through the same cross section of a copper conductor gives the same heating effect no matter what the shape of the conductor or whether it is near the other conductors or not.

While direct current will magnetize nearby iron or steel, it does not cause the losses due to inductive or eddy current in them which the alternating current produces. However, with alternating current, where the current changes in magnitude from zero through the maximum to zero again, as well as in direction, 60 times a second (on 60 cycle current, 25 times on 25 cycle) the changes in the current bring in the effect of "reactance," an inductive effect. With direct current a conductor opposes the flow of current by resistance only, while with alternating current, it opposes that resistance plus reactance as well, and reactance is affected by the size and shape of the conductor and by the proximity of other conductors and of iron or steel. For example, if a large electric furnace for making calcium carbide was carelessly installed and supplied, in order, three different sorts of current at the same voltage, the furnace might take 5000 kilowatts on direct current, 4000 on 25 cycle, and 2500 on 60 cycle alternating current. By proper subdivision and interlacing of the leads, and avoidance of nearby iron, the last two figures might be brought up much nearer the first.

It is not necessary to go deeply into the various effects of reactance, such as the power factor, skin effect in conductors, eddy currents and other losses in nearby iron or steel here, but these factors exist, and disregard of them may mean that the cost of the leads between transformers and furnaces may be much higher than is necessary and that avoidable losses of energy, which costs just so much per unit as that usefully employed in the furnace, may take place every day the furnace is used.

The foundryman must trust the furnace maker or the central station to specify the proper size and shape of the leads, and to see that they are properly installed. He should be sure that the knowledge of and experience with heavy current conductors, of his advisors is adequate. Generally speaking, the shorter the secondary leads, from high tension transformers to the

*Compare Lindstrom, A., Leads for Electric Furnaces, Met. and Chem. Eng., Vol. 16, 1917, p. 683.
Holmgren, F., Problems in Electric Furnace Smelting, Chem. and Met. Eng., Vol. 23, 1920, p. 165.
Anon., Low Tension Conductors for Electric Furnaces, El. Rev., Vol. 76, 1920, p. 267.
Meyer, A. A., Electrical Characteristics of Electric Furnaces, Trans. Am. Electrochem. Soc., Vol. 31, 1917, p. 97.
Flinterman, R. F., Electric Steel Castings, Trans. Am. Electrochem. Soc., Vol. 33, 1918, p. 263.
Anon., Frequency for and Capacity of Electric Furnaces, El. Rev., Vol. 75, 1919, p. 1069.
Editorial, Transformers for Electric Furnaces, El. World, Vol. 75, 1920, p. 880.

furnace and the greater their distance from girders and structural iron work, the better. The ideal arrangement is to have the high tension switches, meters, etc., in a properly enclosed room, kept locked against intrusion so as to prevent danger to life from high voltage current, with remote control switches on the furnace switchboard for throwing high tension current off and on.

One fatal accident occurred on a direct-arc furnace of higher voltage than the most modern form on which the primary switch was not controlled from the furnace. A workman was putting the furnace into shape after relining and stood so that his body made contact between the upper and lower electrodes. A fellow workman evidently became confused as to which of two switches at some distance from the furnace was the one that controlled a circuit that he wished to close, and he closed the one to the furnace, with the result that the man working on the furnace was killed. Under working conditions there usually is no danger whatever in an electric brass furnace properly installed, but even the low voltages in use are dangerous, since if, as in the case cited, a low voltage, high current circuit is passed through the body, the results may be fatal. The safe way is to open the high tension circuit entirely when one wants the current off, and to do this from a control board at the furnace. All the commercially used electric brass furnaces may be installed so as to be safe, if the installation is properly made.

The transformers should be placed out doors wherever possible, or else in special transformer rooms or cells. High tension current should not come into the foundry itself, if it can be avoided.

To get short secondary leads, the furnaces preferably are put close to a wall, with the transformer directly back and on the other side of the wall. The higher the current in the secondary leads, the more important it is to have them short.

Guarding Against Losses

Besides the energy losses in the leads there are losses in the transformers and in the electrodes, but these depend on proper materials, design, and proportioning, and are problems for the makers of the transformers and the furnaces.

As soon as a furnace is installed, a comparison should be made between the reading of the kilowatt-hour meter on the primary, back of the transformer and leads, and of that on the furnace switchboard by which the furnace is operated, if this, as is usually the case, is connected on the secondary side and shows the energy that gets to the electrodes, but does not include transformer and lead losses. If such a comparison shows not much over 5 per cent loss between the power on the primary side, (what is paid for) and that on the secondary, the installation is good. A loss of 10 per cent would not be unusual if the secondary leads are long. Higher losses would indicate that the installation probably could be improved.

The first refractory lining for a furnace usually is supplied by the furnace maker. After that is worn out the user may and usually does, sooner or later, try some other lining, and he may experiment with all sorts of refractories and with large bricks, even one piece liners in some cases, small bricks, and with rammed-in linings.

Try Different Refractories

On account of changes in prices of refractories, and varying freight rates, different refractories may be called for in different localities, or in the same locality at different times. Each type of furnace has its own peculiar requirements and the nature of the charge, the amount and nature of slag-forming, non-metallic impurities, and the way the furnace is run, all have a bearing on the refractory problem.

The ideal lining would never wear out, would allow no heat to escape through it, and would itself take up no heat. No lining is ideal in any one of these points. Each factor is of about equal importance Long life is desirable, and the less often the furnace is down for relining the lower the cost, not only of refractories and labor for laying them, but also of the overhead on a nonproductive furnace. However, long life may be attained at too great an expense for electric heat lost through the lining, and through lowered production due to this heat loss. A lining of low heat conductivity is more necessary in an electric furnace than in a fuel-fired one, so the lining usually is thicker than in fuel-fired furnaces of similar size.

However, if an electric furnace is to be used only for a few hours, say, nine hours a day, the heat storage in a thick lining may be too great. The inside of the furnace lining, depending on the type of furnace, must be heated up to, or above, the pouring temperature of the metal before the metal can be tapped. The temperature varies through the lining from inside to outside. Now, if the refractory has too high a heat conductivity, the lining must be heated nearly to this temperature for a considerable depth before it ceases to drain the heat away, and allows the inside to reach full operating temperature. In some furnaces of great wall area in comparison to their metal capacity, large amounts of heat must thus be drained from the inside and stored in the walls during the first two or three melts of the day. This heat leaks away through the furnace shell when the furnace is idle nearly as fast as it does while it is running, so the next morning the walls have again to be supplied with the heat they have lost through the night. On continuous operation, the walls become saturated with heat or, the furnace has reached the *steady state,* so that each heat comes out in the same time, and the energy supplied is consumed in useful work or lost through radiation from the walls during the heat rather than in heating up the walls. On nine-hour operation, on the first few heats of the morning, it is necessary to supply not only the shell losses during that heat, but also energy to make up for the shell losses of the night before.

High heat storage therefore means low production and low thermal efficiency, when the furnace is not run continuously. It might pay to make a furnace lining, as light as 2 inches thick and, if necessary, water-cool the outside to keep the lining from melting, on a furnace to be run but a few hours per day. If one lost an average of 20 kilowatts per hour for 24 hours, with a thick lining, he has to supply 480 kilowatt hours in whatever time the furnace is run, say eight hours, 320 kilowatts of this being stored and lost at night. He could lose 30 kilowatts average per hour for eight hours, and if the furnace had a storage of only 100 kilowatt hours he could not lose more than that in the remaining 16 hours, or a total of 420 kilowatt hours. He then would start with a dead cold furnace each morning, but he would be 60 kilowatt hours to the good on his day's run. St. John* has shown several diagrams of the distribution of heat losses which bring out the important role played by stored heat.

Stored Heat a Factor

It is the stored heat lost at night which cuts a large percentage figure in a small furnace and prevents the usual types of externally heated crucible furnaces from having any chance of commercial usefulness. The lack of stored heat, due to the need for only a thin heat-insulating wall, makes the high frequency furnace, with its internally-heated crucible, a possibility for intermittent work in the small sized units.

*St. John, H. M., Commercial Testing of Metallurgical Electric Furnaces, Chem. and Met. Eng., Vol. 21, 1919, p. 388.

The inside of the lining must be refractory enough, not only merely to resist fusion, but to stand up against the atmosphere, the metal or the slag with which it is in contact Most refractory materials commonly available have a high heat conductivity, and a high specific heat, i.e. they tend to give both high wall losses and high heat storage. If only such a thickness of this high temperature refractory be used as will keep the temperature at its back down to some lower temperature at which some other less refractory material of lower heat conductivity and heat storage will stand up, the second refractory then becomes a better material for that layer of the lining than the first.

Past a certain thickness of the second refractory, a third material, still less refractory but of still higher resistance to heat flow, and of lower heat storage capacity, then surpasses the second. Even more layers could be used. Still better would be a brick that varied in composition and properties from one end to the other, since too many layers of thin bricks give mechanical instability. Some progress is being made in the experimental production of such bricks, especially carborundum—fireclay mixtures.

Use Stratified Lining

Nearly all electric furnaces use at least two layers of refractory material. The outside layer, next the shell is the easiest to select, since infusorial earth and infusorial earth products have the needed properties. Heavy asbestos sheets or asbestos cement sometimes are used.

A low grade firebrick usually fills the requirements for the middle layer fairly well, but the inner layer is the real problem. Most electric brass furnaces use high grade firebrick, especially those high in alumina. Some use silica brick. On account of the danger of spalling due to heating and cooling, which is shared by magnesite and silica, these materials seldom are used in furnaces for intermittent operation Carborundum brick has been used in roofs and heating troughs. Its heat conductivity is high for use in the body of the furnace, though it finds some use for that purpose. Carborundum brick, especially the bonded type, have great resistance to spalling and abrasion. Hartmann and Kohler* show some striking photographs which bring out clearly the superiority of such brick, as well as of high grade firebrick, as to spalling on rapidly cooling from 1350 degrees Cent., over silica or magnesite brick, which spall badly.

Chromite brick is of doubtful value in the furnaces that have a strongly reducing atmosphere, as it tends to be reduced into ferrochrome.

Zirkite brick, made from crude zirconia ore, is tantalizingly close to a valuable refractory, but its price is too high to be justified until its properties are improved. When pure zirconia refractories become available they bid fair to give a most desirable combination of properties.

Alundum, or electrically fused alumina bricks also have possibilities, though they are expensive and are not yet developed far except for laboratory use. Alundum cement, however, is of great value in some parts of some electric brass furnaces because of its combination of refractoriness, good bonding power, and its ability to remain an electrical insulator at temperatures at which other refractories become conductors Carborundum and alundum are, and pure zirconia refractories probably will be, electric furnace products themselves.

As laboratory experiments, and still more important, plant tests, go on with improved refractories, the life of electric furnace linings should be greatly improved, and relining costs per ton lowered. It also is hoped that a lining for the induction type may be found that will allow that type to handle highly leaded alloys The makers are working with refractories of the type used for making graphite crucibles, with some hope of success.

Small amounts of heat theoretically may be saved, by painting the furnace shells with aluminum paint or even nickel plating them, since good reflectors lose less heat than dull black materials Such a bright finish makes a nice-looking furnace and probably saves a few kilowatt hours—as long as it stays bright, which is seldom long in a foundry.

One of the most vital points in the installation of an electric furnace—of any furnace for that matter, but especially the electric furnace because of the bad effect of delay on production, efficiency and cost in general—is its proper location in the foundry. Consider one furnace which is mechanically charged, and is located so that the metal does not have to double on its tracks, but goes in a straight line from metal storage, to furnace, to molds. In the last stage, generous sized ladles are brought direct from the ladle heater by a suitable overhead trolley, then taken to the molds by as short a path as possible, to avoid the necessity of too great superheating of the metal. Consider another furnace of the same make and size, melting the same materials but set in an out-of-the-way corner, to which the metal is wheeled by hand, and charged by hand, and from which small ladles are carried by hand a long way to the molds, the incoming metal and the ladles meeting in confusion. The melting cost sheets of the former will show a marked superiority to the latter.

Mechanical charging is a great advantage, and even though a foundry may plan to stick to hand charging at first, it is wise to install such types of furnaces as are capable of being adapted to mechanical charging in a place with sufficient room to allow later installation of overhead equipment.

*Hartmann, M. L., and Kohler, J. F., Physical Characteristics of Specialized Refractories, Trans. Am. Electrochem. Soc., Vol. 37, 1920, pp. 349, 355.

Sells Foundry Interest

W. L. Sherwood, who formerly conducted a foundry and machine shop for the manufacture of wood working tools in Ft. Worth, Tex., has disposed of his establishment to Amick Bros., who will operate it as a foundry and shop machine shop. Part of the equipment was sold to the Two-Cure Retread Mold Co., Inc., of which company Mr. Sherwood has been made superintendent. The latter company contemplates the construction of a foundry within the next few months.

Bases Made from Old Crucibles

In one foundry bases for crucibles are made from the old crucibles by cutting off the bottoms at the proper height and then filling them with a mixture of 80 parts carborundum fire sand, 20 parts of batch clay and 14 parts of silicate of soda. The batch clay consists of equal parts of red clay and coarse sand. The blocks when filled are allowed to dry gradually and then are baked. The blocks are said to last for as high as 125 heats.

Hold Housewarming Exercise

The new plant of the Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, recently was dedicated by housewarming exercises held under direction of a committee composed of Harry W. Allen, John W. DeWalt and Robert H. Thompson.

The Frazer Laboratories, Inc., recently have removed from 531 Main St., to 52 Niagara street, Buffalo, N. Y. Bruce E. Frazer, the head of this organization is a consulting engineer on foundry subjects.

How and Why in Brass Founding

By Charles Vickers

Remelting Insulated Copper Wire

We would like to learn what percentage of loss is considered good practice in melting brass. We also desire information on the subject of using scrap copper wire, from which insulation has been burned, in alloys for making castings that must withstand a pressure of 200 pounds per square inch.

The percentage of loss in melting copper alloys will vary with the composition of the alloy, and the degree of skill expended in melting. Alloys high in zinc, as for instance, yellow brass, lose more than alloys composed of copper and tin, or copper, tin, zinc and lead. This is because zinc is a volatile metal, that is, it distills out of the mixture when the latter is molten. Obviously, if the alloys have to be brought to a high temperature in order to properly pour the castings, the loss will be higher than if cooler metal could be be used. In the case of yellow brass a loss of 2.5 per cent net can be considered good practice. Bronze will lose about 1.5 per cent, and copper will not lose more than 1 per cent. Whether scrap copper wire is suitable for pressure castings will depend largely upon the kind of insulation that was burned off. If the wire is cotton covered, it can be put in shape to produce alloys free from porosity by burning off the covering quickly, cooling in water, drying and compacting into a solid mass. However, if the wire is covered with material containing rubber it is not suitable for such castings. When the insulation is burned the sulphur contained in the rubber will combine with the copper, and after the latter is melted and takes up oxygen, a gas will form in it that will produce porous castings.

If the wire is bought before the insulation is burned off, the rubber covered wire can be separated and reserved for unimportant castings. The wire not covered with rubber, ought to produce satisfactory castings, but it should not be melted alone unless compacted into a solid mass. If it has to be melted in a loose condition, roll it into balls that will enter the crucible. First melt ingot copper or the brass part of the charge if the latter is to be used in the heat, then introduce the copper wire, submerging it in the melted metal. Feed the wire as fast as the melted metal will take it without freezing. When all the copper has been added and has warmed up again, stir the alloy thoroughly, add the white metals, again stir, and pull the pot. After skimming, scatter a small amount, about 0.25 per cent, of shotted phosphor copper over the surface of the metal, then stir the surface metal to incorporate the shotted phosphor copper. This will liquify the top layer of metal in the crucible and permit the gases that may be held in the body of the metal to escape. Just before pouring, thoroughly stir the metal to the bottom of the pot. Handled in this manner, the scrap copper wire will produce as good results as ingot copper.

Preventing Cooling and Shrinkage Cracks

We would like to learn why the small brass castings of which a sample is sent, crack in the manner that will be noted. The casting is a bushing approximately 2 inches in diameter, 2 inches in length, with walls ¼-inch thick, and having a wide, thin flange on one end. The cracks appear under the flange at the junction with the body of the bushing, on the parting of the mold, about half in the cope and half in the drag. The alloy is a yellow brass analyzing approximately, copper, 64 per cent, zinc, 34 per cent; lead, 2 per cent. With the exception of the cracks the castings appear to be sound.

The cracking is due to a strain put on the casting because of its shape and its position in the mold. Probably the casting is molded vertically, the flange being uppermost. At the opposite end of the bushing there is an internal flange, which is formed by a circular recess in the core. The two flanges serve to anchor the metal at both ends and prevent its free contraction. The latter phenomena cannot be prevented by any means known, therefore, as the two ends are firmly held, something has to give, and the weakest part is the junction line of the large flange with the body. The heaviest section of metal is at this line and this causes the part to cool more slowly than the rest of the casting. Therefore, it is the most tender part of the casting at the critical time when contraction occurs in the metal.

This is the cause of the cracking; to prevent cracking, the cause must be removed. One end of the casting must be made free to move towards the other. How best to do this is a problem in molding that must be worked out by experimentation. Suggestions are all that can be offered here. Possibly if the core print at the bottom is made short and tapering, and if the cores are hollowed out inside to lighten them, the metal will have strength sufficient to lift the core, so the two ends can come together. This will prevent cracking. That all the castings made are not cracked shows that some freedom of movement must take place in the majority of cases. The core must be lifted up, and when it is firmly anchored down by the metal getting around the print, or by having been squeezed firmly into the print; then the casting cracks. A short cone-shaped core print, and a core that is light and easily burnt will aid greatly in overcoming the cracking. The surest way to avoid the cracking would be to roll the mold over after it is made, and pour it with the other end up. The weight of the metal then would aid the shrinkage of the casting, and it is inconceivable that cracking could occur under such circumstances. Rolling a mold over before pouring, however, adds to the labor, and fewer molds are made, and with unskilled help, sand is likely to enter the sprue if the bottom board slips in rolling over. However, we believe a little study along the lines suggested will eliminate the cracking.

Roll Bearing Alloys

We have been making bearings for rolling mill rolls, but have had difficulty in getting the castings strong enough. They appear to be good until the water is started onto them, when they commence to disintegrate. We would like to get a formula that would be suitable for this purpose.

We suggest a trial of the following alloy: Copper, 85.50 per cent; tin, 9 per cent; lead, 5 per cent; phosphor copper, 0.5 per cent.

The phosphor copper should be added to the copper when the latter is molten and before the other metals.

Study of Impact Tests on Alloys

Tests Made on Impact-Shear Machines and on Alternating-Impact Testers Indicate the Relative Value of Various Alloys—Machining Bars Found to be Unnecessary for Impact-Shear Test

BY AUSTIN B. WILSON

WHILE tensile tests on metal have been made for a long while by many firms, impact tests are of more recent origin and comparative little is generally known of the properties of metal under this type of test. A series of impact tests was made with three different machines on various bronzes to secure more data on the behavior of these metal under impact.

With one or two exceptions these tests were made on bronzes which are recognized as standard and which are more or less widely known. Table III designates the alloys by number and gives their general physical properties, chemical composition, particular use, etc.

The tests made were of three distinct classes, namely McAdam impact-shear tests with unnotched bar, Fremont direct impact tests with notched bar, and Landgraf-Turner alternating-impact tests.

The machine shown in Fig. 1 is the type used for Fremont tests The vertical shaft guides a weight which falls on a knife edge about ½ inch wide which is affixed to the bore. The test piece is placed, notched side down, across a rectangular opening in the bed of the machine. The knife edge strikes the test piece which breaks instantly and allows the falling weight to drop upon a set of calibrated springs which registers the remaining energy in kilogram-meters. The difference between the energy developed and the residual energy gives the energy absorbed in causing rupture.

Fig. 2 shows the McAdam impact-shear machine. To operate it an unnotched test bar is placed in position, the pendulum raised by means of a hand winch to a height which develops a given energy—in these tests 400 foot pounds—and released. The pendulum swings downward and shears off the specimen by means of a knife edge. The remaining energy is registered on the scale and the enery absorbed is calculated as in the Fremont test.

Each of these two tests has its own particular field, as tests on unnotched bars would not be a good criterion of the service which a material would give in service where a *notched* effect was present, and vice versa. It is well known that a stress applied to a bar which has a sudden change in cross section along its length produces a decidedly nonuniform strain distribution at the change in cross section. If the change in cross section is in the form of a nick or groove, the strains at the base of the nick multiply and are much greater than the average strain over the cross section. The strains are localized at the bottom of the notch, thereby decreasing the strength of the material many times more than the reduction in cross section would indicate. This effect increases as the angle of the notch decreases. An illustration of this is the nicking of a bar by a workman before breaking. In many cases the unnicked bar would merely bend whereas the nicked bar breaks readily. In addition the impact-shear test has been found to give very good indications of the ease with which the various

Table I
Alternating Impact and Impact-Shear Tests

	Alternating impact test Bar ⅜ inch diameter Alternations endured	Impact shear Test, machined ½ inch x ⅜ inch	Average foot lbs. machined ⅜ inch diameter	To shear As cast average per square inch
	2490 •	111.25	75.25	
	1930	122.75	71.25	
	780	105.75	58.25	
	930	38.25	29.50	304
	375	70.75	13.75	108
29	810	102.25		198
33	15	32.00		194

Table II
Impact-Shear Tests Calculated to Percentage

Alloy	Machined, ½ inch x ⅜ inch	Machined inch diameter	Not machined Calculated per square inch
	100%	100%	100%
		99%	113%
10		77%	80%
15		39%	41%
28	49%	58%	54%
	71%	73%	66%

The author, Austin B Wilson, is engineer, the Titanium Alloy Mfg. Co., Niagara Falls, N. Y., which company furnished the test pieces for this series of tests.

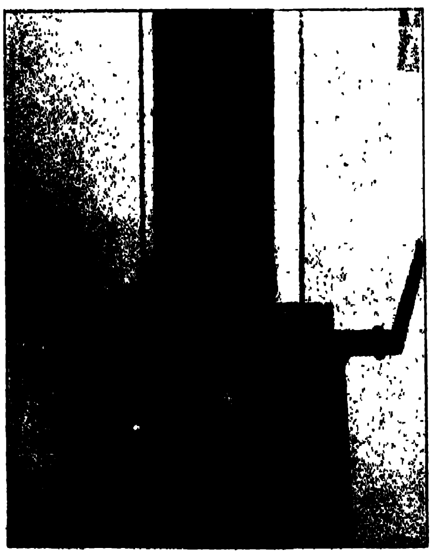


FIG. 1—MACHINE USED FOR FREMONT TESTS

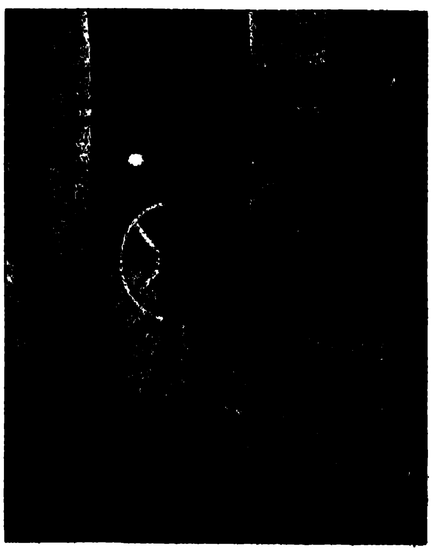


FIG. 2—McADAMS IMPACT-SHEAR TESTER

alloys can be machined, low results indicating that the material could be machined easily, high results that it would be harder to machine.

The Landgraf-Turner machine shown in Fig. 3 is used for making alternating-impact tests. This test is similar to the one advocated by Professor Arnold, Sheffield, England. The lower end of the test piece is clamped in the machine as shown. The upper end extends through a slot in the hammer which moves back and forth, thus bending the bar, at the point where it enters the clamps, far past its elastic limit. Failure occurs in, at most, a few thousand alternations. The number of alternations is recorded on an automatic counter. This test gives a quick and fairly reliable indication of what may be expected from materials in actual service when subject to alternating stresses.

Several series of tests of each kind were made. Table I gives the average results of a large number of two of these kinds of test. In Table II a general summary of the impact-shear tests shown in Table I is given. For purposes of comparing, not only the resistance to impact-shear of the different alloys but also the various methods of testing, these results have been translated in Table II to percentages. In each case alloy 2 has been taken as 100 per cent for a basis of comparison.

A study of this table will show the results to be unusually uniform and consistent. Although the use of round bars for this test is not theoretically correct on account of the energy lost in deforming the bar, the results are almost identical with those obtained on the rectangular bars. Considerable energy was also lost in deforming the bars tested as cast, probably on account of being a little too thick. There was a slight variation between the bars which were machined and those not machined. The former, as a rule, gave slightly lower results due to the removal of the outer skin. With alloy 29 this was reversed.

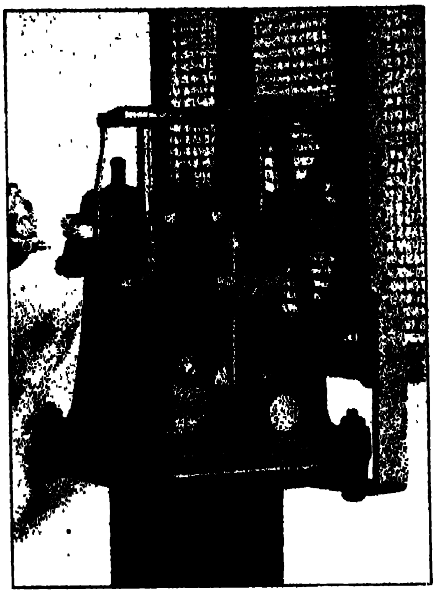


FIG. 3—MACHINE ON WHICH THE ALTERNATING-IMPACT TESTS WERE MADE

As these tests indicated that it was unnecessary to use machined bars, another set of bars were tested. Before making the impact test, the quality of the bars was checked by tensile tests and only bars with properties closely approximating those shown in Table III were used.

Alloy	Impact-shear tests Ft. lbs. per sq. in.	% Based on alloy 2
2	727	100
4	808	110
5	820	114
8	533	73
10	518	71
29	602	83

The foregoing results show the aluminum bronzes to be the most resistant to shear. Alloys 4 and 5 gave about equal results.

Two of the alloy 5 bars were heat-treated by quenching from 920 degrees Cent., reheating to 600 degrees Cent. and furnace cooling. This, it was thought, would increase the resistance to impact-shear, but such was not the case. An average of six tests on bars, not machined, gave 652-foot pounds per square inch which is only 91 per cent based on alloy 2.

The results of alternating-impact tests on bars are as follows:

Alloy	Alternations endured
2	4260
4	4500
5	3600
8	570
10	1080
29	600

These tests are of interest as they show both alloys 2 and 4 to give about the same results as have been obtained on alloy 5 from time to time. Alloy 10 gave better results than have ever been obtained on alloy 29. The low result for alloy 5 was due to a slight defect.

Only metal known to be of good quality was used for the Fremont tests

(Continued on page 622)

Table III

Average Composition and Tensile Properties of Alloys Used In Impact Tests

Alloy No	Known as	Condition	Cu	Al	Sn	Fe	Zn	Pb	Mn	Yield Point lbs. per sq. in.	Max Strength lbs. per sq. in.	Elongation Per cent	Reduction Per cent	Brinell Hardness	Elastic Limit in Compression	Particular Use
2		Cast	88.0	8.0		4.0				26,000	80,000	35.0	32.0	109	23,000	Heavy castings of great toughness.
3	Stone's English Gear Bronze	Cast	80.0		11.0					22-25,000	35-40,000	6-10.0	7-9.0	80	16,000	Worm gears under severe conditions.
4		Cast	80.0	10.0		4.0				35-40,000	80-85,000	18.0	18.0	130	21,000	Castings requiring great strength.
4		Heat-treated	[illegible]	10.0		4.0				50-60,000	90-100,000	15.0	15.0	160	50-60,000	Castings requiring strength and hardness.
5	Titanium Aluminum Bronze	Cast	89.0	10.0		1.0				24-30,000	70,000	[illegible]	27.0	100	19,000	Resistance to repeated shock.
5		Heat-treated	89.0	10.0		1.0				45-55,000	85-95,000	15.0	15.0	140	45-55,000	Castings requiring strength and hardness.
8		Cast	88.0		8.0		4.0			18-22,000	34-48,000	19-35.0	20-30.0	60-70	14,000	Dense castings.
10	Gun Metal	Cast	88.0		10.0		2.0			19-23,000	32-38,000	14-18.0	12-15.0	70-75	15,000	Hydraulic work.
15	Phosphor Bronze	Cast	80.0		10.0			10.0		19-21,000	28-32,000	5-7.0	6-10.0	55-60	12,000	High-speed and heavy-pressure bearings.
28	Pure Copper	Cast	99.6-.9							6-9,000	17-20,000	40-50.0	60-70.0	30-40	4,000	Where high electrical conductivity is required.
29	Manganese Bronze	Cast	56.0	0.5	1.0	1.0	41.0		0.5	33,000	70,000	22-35.0	25.0	104	28,000	Propeller blades, etc.
32										11-13,000	16-22,000	1-2.0	1-2.0	50	10,000	Crank cases, etc.

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Users Can Aid Shippers

SAND scarcity, based upon the inability of producers to obtain cars, is a source of concern to many foundrymen as winter approaches. Distributors of molding, core-making and sandblast sand are fully aware of the danger which threatens, and are making every effort to obtain any sort of railway cars which may be had so that some sand reserve may be accumulated by their customers before Dec. 1. Through its secretary, the American Sand association has presented the needs of the industry to the interstate commerce commission, and the opinion is expressed that, governed by war-time precedent this body will favor the effort to sustain the sand supply. The essential character of sand was established when priority ruled during the war, and the same status should obtain in the present crisis. No effort has been made to belittle the importance or to enter into competition with any other commodity in the struggle for shipping facilities, but the case of the sand producers and their relation to the foundries of the country has been set forth in some detail. On another page of this issue is a short resume of the sand situation. Probably each foundryman could, from his own experience, add much to what has been given. The question of whether sand shortage shall shut off or limit foundry activity is of vital concern to every plant manager. Each can do his part, either through the association of foundries with which he is affiliated, or as an individual. The interstate commerce commission should be appraised of the situation, and each buyer of sand should endeavor to obtain a shipping permit, as he will stand a better chance of success as a consumer than will the producer from whom he purchases his supply. Such permits are the only means by which shipments may obtain admission to embargoed territory and are of marked benefit in obtaining cars.

Attention To Details

SOME foundrymen know how to melt iron and rig for making castings, but fail successfully to produce a satisfactory output because enough attention is not paid to detail. It is easy to blame the trouble on the carelessness of the molders. Perhaps this may be true in some instances, but it is possible to train the molders so that they are not careless and to plan the work so that the molding operation is so simple as to be proof against carelessness. After every precaution is taken to rig the pattern correctly, it then should be put up to the molder to produce good castings. In one foundry, all bad castings are delivered to the floor on which they are made. In this way the molder knows every day the number of bad castings made the day before. As he is paid on the piece rate basis he has an opportunity to complain if defective castings are being charged against him when the fault is due to some factor beyond his control. The molder also can determine what has caused the defects and an incentive is supplied to remedy his practice, which otherwise might continue in error leading to carelessness and further loss. Should the loss become excessive, the foreman tries to find the cause and if he cannot correct it, a conference is called with the superintendent who goes to the molder's floor and discusses the problem with the molder and the foreman. These conferences often bring out defects in the rigging to be righted.

Trade Outlook in the Foundry Industry

INDUSTRY as a whole at present has one major problem which transcends all others. Transportation, vital to all, is particularly essential to foundries which have been unable in the past year to accumulate any reserve of raw materials. Pig iron, coke and sand alike have dribbled through to plant sidings with increasing slowness. Car shortage has threatened all raw materials, and has hampered deliveries of finished products.

Coal Is King

The return to quasi-government control has been noted. Order No. 9 of the interstate commerce commission limited the use of open-top cars to the shipment of coal. This later was extended to about Aug. 20 and modified in some degree by interpreting coal cars as that class of open-top equipment which had sides over 36 inches high. Despite these provisions favoring mines coal shipments have not been increased as greatly as had been expected. The modification of the original order will allow a longer time in which betterment is expected. A further order of the commission has allotted a certain amount of coal to be shipped to lake ports for transfer by water to the Northwest. This movement is just starting, and foundrymen in lake terminals fear that it still further will complicate their transportation difficulties by adding to yard congestion. All these orders issued by the government for the control of coal are taken by some to presage the restoration of maximum fuel prices. Coke production, based upon and entirely governed by the coal supply has shown little improvement. Practically no reserve of coke has been accumulated by foundries.

Prices of Raw Materials for Foundry Use

CORRECTED TO JULY 26

Iron		Scrap	
No. 2 Foundry, Valley	$45.00	Heavy melting steel, Valley	$25.00 to 26.00
No 2 Southern, Birmingham	42.00	Heavy melting steel, Pittsburgh	26.00 to 26.50
No. 2 Foundry, Chicago	44.00 to 45.00	Heavy melting steel, Chicago	23.75 to 24.25
No. 2 Foundry, Philadelphia	49.10 to 50.10	Stove plate, Chicago	31.50 to 32.00
Basic, Valley	46.00	No. 1 cast, Chicago	41.00 to 41.50
Malleable, Chicago	45.50	No. 1 cast, Philadelphia	37.00 to 39.00
Malleable, Buffalo	46.25	No. 1 cast, Birmingham	32.00 to 35.00
		Car wheels, iron, Pittsburgh	39.00 to 40.00
Coke		Car wheels, iron, Chicago	35.50 to 36.00
Connellsville foundry coke	$17.00 to 18.00	Railroad malleable, Chicago	31.00 to 31.50
Wise county foundry coke	19.00 to 20.00	Agricultural malleable, Chicago	29.00 to 29.50

Buying 1921 Iron

Although coke has been harder to obtain, foundries have been only slightly more fortunate in securing metals. Few if any have a surplus of either pig iron or scrap. Some iron still is being sold for last quarter shipment. Southern furnaces and a few in the North have taken orders for 1921 shipment. The first quarter price on southern No. 2 has been the same as that prevailing at present, $42, Birmingham. Much uncertainty is expressed regarding the wisdom of buying iron far into the future. Some hold that a slackening demand and tightened credit conditions may bring receding prices, and therefore they are delaying the purchase of iron. Others see in mounting coke costs and impending freight advances signs of still further increase and are placing at least a portion of their first half 1921 requirements. At Cincinnati inquiries for pig iron for both prompt and future delivery continue to increase. The southern market is firm at $42, while northern iron is strong at the unchanged quotation of $45. The Chicago market was somewhat upset by the inability of the Thomas Furnace Co., Milwaukee, to blow in its stack owing to lack of coke. Melters who were counting on securing low-phosphorus iron from this furnace have had to secure the iron from other sources. The demand for iron in the Chicago district is much more active. Both malleable and silveries have been sought. Sales of low-phosphorus iron have been made in lots of 200 and 300 tons by southern Ohio makers. Silveries have been sold in medium sized lots. A Tennessee maker quotes $55 at furnace for 8 per cent pig, while a Jackson county producer continues to ask $58 at furnace for the same grade.

Prices Unchanged

The same upward trend of prices which is noticed in pig iron and coke has not as yet made itself felt in the casting branch of the industry. In fact, approximately 150 tons of manhole castings have recently been purchased in New York for $110 a ton which showed some competition in the bidding as other foundry companies had bids as high as $125 and $150. However, as the cost of metal in the ladle has been increased by the rise of pig iron and coke, there probably will be some adjustment in the price of castings. At present there is a rather wide range in the price of castings. For instance, machinery castings range from 6½ cents to 9 cents a pound in the New York district. In the same market bench work castings sell for from 15 to 20 cents a pound. The market seems to be still a sellers' market although in some lines the demand has fallen. However, the buyer is more apt to find a foundry which will accept his order than he was a few months ago. There is a marked decrease in the inquiry for cast iron pipe, but the shortage of raw material at the shops has reduced operations and so the present orders it is estimated will last for several months. A few foundries notice a slackening in demand for castings for the automobile trade, but any vacancy left by a paucity of orders in this field is quickly filled by orders for castings in different lines. The decrease in requirements for one make of automobile may even be filled by orders for castings from another company, for while the manufacturers of the higher-priced cars are curtailing in their output, the cheapest cars are being made in increasing numbers, and the medium-priced cars are about holding their own although not pressing as hard as formerly for deliveries.

The slackening of demand for automobiles has decreased the call for aluminum castings which are used in greater proportion in the higher-priced cars. Prices of nonferrous metals based on New York quotations follow: Copper, 18.12½c to 18.25c; lead, 8.50c; tin, 49.00c to 49.25c; aluminum, 33.00c; aluminum, No. 12 alloy, producers' price, 32.00c, and open market, 30.00c to 30.50c; zinc, 7.85c, St. Louis.

Comings and Goings of Foundrymen

FRED C. SCHOFIELD has resigned as superintendent of the foundry department of the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., because of ill health, after 34 years of service with it and its predecessors. Before leaving he was presented a gold watch by the company, a gold chain with a gold handled knife attached, a gold charm and $130 in gold by the employes of the foundry. The presentation was made by Charles E. Hildreth, president and general manager of the company. Mr. Scholfield is succeeded by Patrick Jordan, formerly connected with the Everett, Mass., works foundry of the General Electric Co.

R. W. Stargell has been made foundry superintendent of the R. W. G. Foundry Co., Anderson, Ind.

W. L. Sherwood has been made superintendent of the Two-Cure Retread Mold Co., Inc, Fort Worth, Texas.

Robert H. Hunger, son of the late H. J. Hunger, succeeds his father in the management of the H. J. Hunger Brass Works, Cleveland.

Clark T. Dickerman, sales agent for the American Car & Foundry Co, at New York, recently was transferred to that company's Chicago office.

H. C. White recently resigned as factory manager of the Harris Mfg. Co., to devote his attention to the H. C. White Foundry Co., Stockton, Cal., of which he is president and general manager.

Henry Kreisinger, formerly of the United States bureau of mines, has been appointed engineer of research for the Combustion Engineering Corp., New York. He will maintain his headquarters at the Pittsburgh station of the bureau of mines.

E. C. Hummel, who has been superintendent of the Electric Steel Foundry operated by the United Alloy Steel Corp., Canton, O., has purchased a controlling interest and has reorganized the Philadelphia Electric Steel Corp., Philadelphia, which will be known as the Philadelphia Electric Steel Castings Co.

Andrew M. Peterson, president, Brooklyn Foundry Co., Brooklyn, has been designated as Republican candidate for Congress to represent the ninth congressional district in Kings county, New York. Mr. Peterson is without opposition on the Republican ticket and his district is strongly Republican, so that his chances for election are bright.

Carl C. Gibbs recently was appointed manager of the Indianapolis works of the National Malleable Castings Co., Cleveland, to succeed the late Allan S. Bixby. Mr. Gibbs was connected with the Indianapolis plant prior to 1919, when he was transfered to Cleveland as sales agent.

T. D. Slingman has joined the sales organization of the Keller Pneumatic Tool Co., Grand Haven, Mich., as special representative, with headquarters at the company's Pittsburgh office. Mr. Slingman for many years has been identified with the selling organization of the Chicago Pneumatic Tool Co., for the past nine years as district manager at Detroit, Mich.

Start Cost Association

At a recent organization meeting, the Industrial Cost Accountants association was inaugurated with the following officers. M. F. Simmons, supervisor of costs, General Electric Co., Schenectady, president; C. H. Smith, director of clerical operations, Westinghouse Air Brake Co., Wilmerding, Pa., first vice president: Roland H. Zinn, chief, cost accounting bureau, Tanner's Council, second vice president: A. A. Alles Jr., secretary, Fawcus Machine Co., secretary-treasurer. It is the intention of the new association to bring about a greater uniformity in cost accounting methods.

Set Date for Convention

The date for the annual convention of the Institution of British Foundrymen has now been fixed for Aug. 26-28 at Glasgow, Scotland, but the exact place of the meeting has not yet been decided. It is expected that a large number of foundrymen from all parts of Great Britain and northwestern Europe will attend. W. G. Hollinworth, the new secretary of the institution, has taken up his duties.

Book Review

Electric Deposition of Metals, by George Langbein and William T. Brannt; cloth, 863 pages 6 x 9 inches; published by Henry Carey Baird & Co., Inc., New York, and for sale by THE FOUNDRY. Price, $7.50 net.

This new and eighth edition of a well known work has been revised and enlarged. It contains complete information on plating and finishing metals of every description, and is practically an encyclopedia of the art. It is written in plain language with special reference to the needs of the practical plater and metal finisher.

The number of American editions through which this work has passed in rapid succession and the continued demand for it may be accepted as evidence that the book, written from a scientific, as well as a practical viewpoint, has been found to fulfill the purpose for which it was primarily intended.

Due attention has been paid in this latest edition to all important innovations and as far as possible all practical methods of plating which have become known since the publication of the last edition have been included as well as a description of the most recent machinery and apparatus. The subject matter covered comprises: Electroplating, galvanoplastic operations and electrotyping; deposition of metals by the contact and immersion processes; coloring of metals; lacquering; methods of grinding and polishing, and hundreds of tested formulas. Descriptions and applications of voltaic cells, dynamo-electric machines and plating shop equipment are given.

Issues Steel Booklet

In a 100-page booklet that is carefully planned as to details of value to the reader, the Moltrup Steel Products Co., Beaver Falls, Pa., describes its products and presents valuable information on related steel topics. In the foreword the purpose of the booklet is expressed as, "a desire to present a comprehensive view of the purposes, products, processes and facilities that represent the use of various steel products."

Among the first few pages are discussions of cold drawn steel, shafting, and screw stock. Squares, hexagons, flats and special shapes which also are cold drawn as described. Under each of these headings, the explanations include methods of manufacture, outlines of the development of processes, facilities for production, sizes made in manufacture and accuracy required in sizes and shapes.

Following this, the chemical characteristics of the carbon steels are briefly explained. The constituents are taken up separately as to brittle-

ness, tensile strength, etc., when used in varying amounts in steel. The alloy steels, nickel, chromium, vanadium and the combinations of each are discussed in the same manner. Shapes both standard and special into which the steel is made are illustrated. Tables giving the specifications of the Society of Automotive Engineers concludes the section.

Machine keys are explained by charts of dimensions while illustrations show finished steel plates, and adequate diagrams are given of foundry plates.

A third of the pages contain detailed tables giving weights of round, square and steel bars of hexagonal bars, flat rolled steel, flat steel bars, circular steel plates, sheet and bar aluminum and brass, of steel and iron and sheets and plates, circumferences and areas of circles, decimal equivalents of the fractions of an inch, values of fractional sizes expressed in millimeters, standard wire gages with equivalents in decimal parts of an inch, and United States conversion tables.

Design Standard Electric Control Panel

The General Electric Co., Schenectady, N. Y., recently has inaugurated a line of standard unit induction motor panels for use with either wound or squirrel cage motors, operating on three wire non-grounded systems. These panels are designed

CONTROL PANEL FOR VARIED SERVICE

for the control of motors in nearly every application where it is not necessary to furnish the panels with a highly specialized equipment. They are particularly designed for such work as controlling motors which are driving compressors, blowers, centrifugal pumps, and similar machinery.

Protection from sustained heavy overloads is provided by time limit relays which operate the oil circuit breakers, but which, due to the time limit feature prevent the motors being shut down on instantaneous overloads. There also is an undervoltage device which opens the breakers in case the line voltage falls to a marked degree below normal. This prevents the damage that might ensue, if the motor was left on the line when the full voltage was re-established and the operator had failed to take the proper precautions.

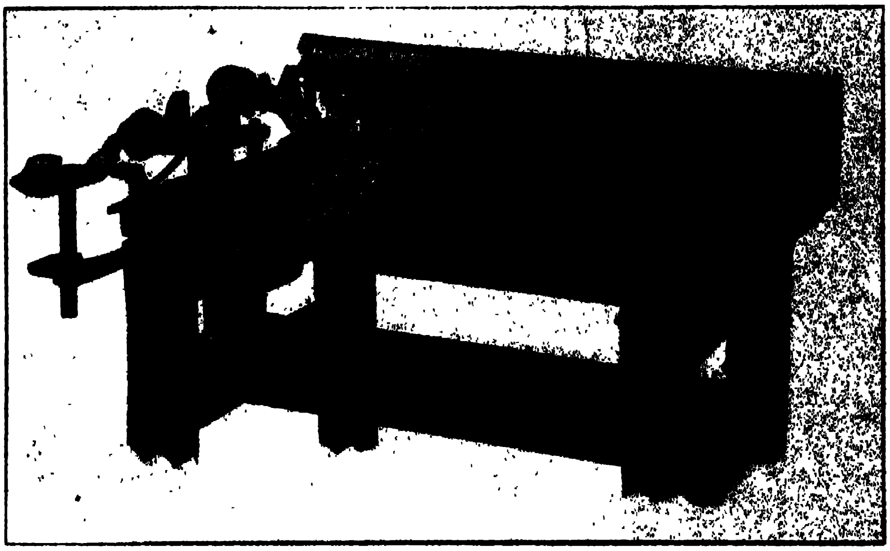
Protection of motors which start on compensators which do not have self-contained switching arrangements is furnished by a time limit mechanical interlock which serves several purposes. In the first place, it prevents the closing of the main breaker before the starting breakers have been closed and then opened. This guarantees the proper operating sequence. Secondly it insures that the main breaker is closed within a short fixed time after the starting breakers have been opened. This is to prevent the motor from being thrown on the line after it has lost too much speed between the time of opening the starting breakers and the closing of the running notch.

A new feature of these panels is the way in which the cable terminals are attached, so that main line cables may be run in straight lines without interfering with the panel parts. For further convenience in installation, these terminals are reversible in most cases so that cable may be run from above or below as it is best suited to the conditions.

The starting breakers now are placed side by side, back of the main breaker, and operated from the panel through conventional remote control mechanism.

New Core Machine Simplifies Operations

The foundry engineering department of the E. J. Woodison Co., Detroit, has designed a new bench core making machine which has been introduced into a number of foundries. This machine can be bolted to any core making bench. The cradle will hold a core box up to 12 x 18 inches with a draw up to 6 inches. The design has been simplified so that the machine may be operated by unskilled labor. The operator stands in one position throughout the entire process of making a core. From his bench he throws the sand into the core box, jolts by hand, strikes off, pulls down a clamping device after which he throws the cradle a quarter turn and the box is on the plate. He then pushes a button to start the vibrator, pushes down the lever until it automatically locks and the core is drawn. The accompanying illustration shows the new machine.



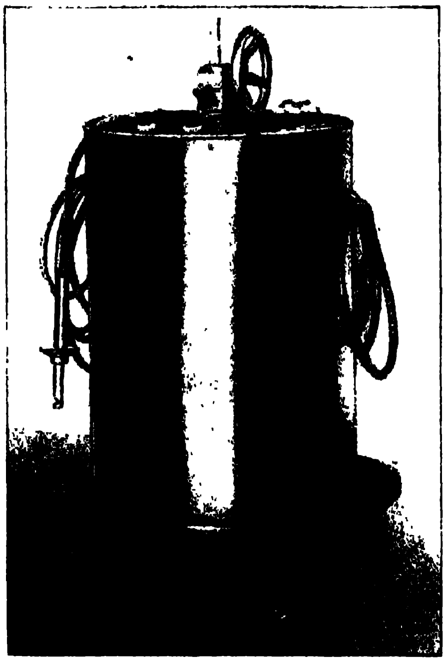
OPERATING MECHANISM IS READILY ACCESSIBLE IN NEW CORE BENCH

The Woodison company has also designed a core machine for use with split core boxes. This machine will draw split core boxes up to 8 inches in depth, but the width and length of the core box may be any size. Two magnets placed horizontally against pads on the outside of the core box vibrate and draw at the same time, while another magnet holds the core plate firm. The machine is built with knee pads on both sides to enable two operators to use one machine. While one coremaker is ramming the core box the other draws his core.

The Canton Pneumatic Tool Co., Canton, O., has purchased the business of the Pittsburgh Pneumatic Co. The new firm will operate under the same management as the old.

Alternating Current Arc Welding

An arc welding set to dispense with the use of a motor generator set required in direct-current welding has been introduced by the Gibb Instrument Co., Detroit. This consists of a transformer and regulator for controlling the voltage on an alternating current line. The transformer consists of nothing but stationary copper and iron which makes its construction rugged. Oil is used as a cooling medium and a fan is not necessary. The inherent reactance of the machine automatically stabilizes the arc and prevents burned welds due to excessive arc length. The arc will become extinguished when attempt is made to lengthen it beyond $\frac{3}{16}$-inch.



ARC WELDING SET

Develop New Type of Monorail Conveyor

The H. M. Lane Co., Detroit, recently has produced a new type of monorail, the general principles of which are shown in the accompanying illustration.

The novel feature consists in providing for the operator a basket or elevator which may be raised or lowered by a telescoping arrangement. The cables connecting the controllers for the various motors all are arranged with a flexible connection, so that the operator at all times has control of the travel motor, the hoist motor and the motor for hoisting himself. This enables one man to go out into the yard with a one or two-hook monorail, pick up a flask and bring it into the foundry without requiring the services of a helper. It also enables him, in gathering up boxes of castings in a foundry gangway, after they have been loaded and allowed to cool for a while, to pick them up, taking care of his own hitches in the foundry and his own releases in the cleaning room. In cases where a laborer is absolutely necessary, the laborer may ride in the cage with the operator to the point where he is wanted, and the cage can be lowered to such a position that he can drop and attend to the hooking. Also, in some cases, both laborer and operator may work together in handling flasks or other equipment.

Study of Impact Tests on Alloys

(*Concluded from page 617*)

on notched bars and the results from one or two specimens, which showed defects in the fractures were discarded. The tests were made on specimens machined to exactly the same size. The following are the results of these tests:

[illegible]	Condition	Average kilogram-meters required to break
2	Sand-cast	12.3
3	Sand cast	2 2
3	Chill-cast	3.3
4	Sand cast	3.0
4	Heat-treated	10.5
5	Sand-cast	9.4
5	Heat-treated	7.4
[illegible]	Chill-cast	10.1
[illegible]	Sand-cast	7.9

Evidently alloy *2* is the most resistant to shock when any *notched* effect is present. Alloy 4, heat treated, and alloy 5, chill cast, come next showing little difference. Heat treatment benefitted alloy 4 but not alloy 5.

From the results reported there are certain conclusions which may be drawn. These conclusions have from time to time been borne out by individual tests made to check the value of castings for different purposes. It is indicated by these tests that:

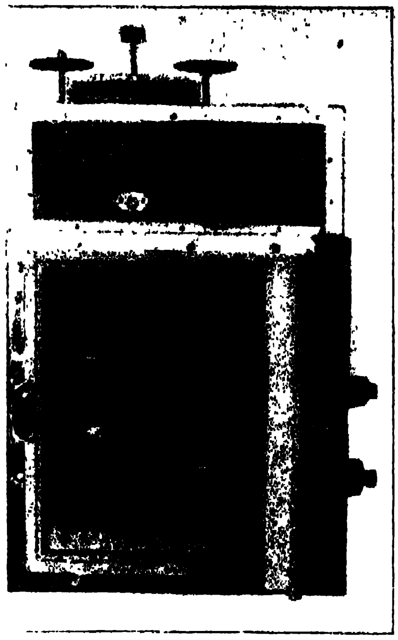
All of the aluminum bronzes tested excelled any of the other bronzes of the series in resistance to impact by shearing.

For impact-shear tests it is not necessary to use machined test-pieces.

Aluminum bronze—especially alloy 2—showed high resistance to direct impact where *notched* effect was present.

In resistance to failure through fatigue as evidenced by alternating-impact tests aluminum bronze surpassed the other bronzes which were tested.

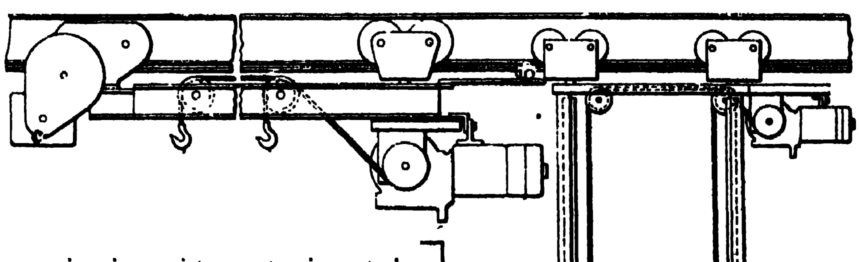
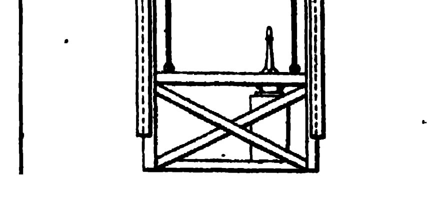
Sound *G* metal—alloy 10—is at least equal, if not superior to manganese bronze—alloy 29—in resistance to fatigue and in toughness.



MOISTURE TESTER WEIGHS SAMPLES WHILE THEY ARE IN THE DRYING OVEN

Moisture Tester Dispenses With Desecators

A tester for rapidly determining the moisture in several samples of material at the same time has been put on the market by the Williams Apparatus Co., Watertown, N. Y. This apparatus consists of a double walled asbestos oven which is electrically heated. The temperature is held indefinitely at any desired degree by a thermostat. A balance is located on top of the oven. A pan hanger passes down from this balance into the oven, and the material is weighed without removing it. This avoids the use of dessicators. A pan rack is fitted in the oven to hold sev-

CONVEYOR HAS CAGE FOR OPERATOR

eral samples which may be dried at the same time, it being only necessary to transfer each pan to the suspension hook for final weighing.

Obituary

Henry J. Hunger, president, the H. J. Hunger Brass Works, died Tuesday, July 6. Mr. Hunger was born in Germany and came to this country at the age of 12, settling in Cleveland. In 1899 he and Gottleib Scheidegger established the brass foundry. The partnership was dissolved in 1916.

Kenneth W. Blackwell, vice president of the Canadian Steel Foundries, Ltd., who died June 11, at his home in Montreal, Que., after a brief illness, was born in England in 1850. He arrived in Canada as a boy with his father, Thomas E. Blackwell, who was the first general manager of the Grand Trunk railway. Kenneth Blackwell was apprenticed as a mechanical engineer in that road's shops, Point St. Charles, Montreal, later being appointed mechanical superintendent for its division between Montreal and Toronto, with headquarters at Belleville. He later became mechanical superintendent of the Chicago & Grand Trunk railway and then became connected with the Canadian Pacific in a simliar capacity. In 1882 he commenced to manufacture railway car springs, etc., as K. W. Blackwell and the business later became a joint stock company with Mr. Blackwell as president. This company later became the Montreal Steel Works, Ltd., with him as president and managing director. It was absorbed by the Canadian Car & Foundry Co., under the name of the Canadian Steel Foundries, Ltd.; Mr. Blackwell becoming vice president, the position held by him at the time of his death. He was director of several large industrial companies and was also a past president of the Canadian Society of Civil Engineers.

Since control of the Cooper Hewitt Electric Co., Hoboken, N. J., was assumed by the General Electric Co., Schenectady, adjoining property has been purchased which will more than double the present floor space.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The plant of the Keystone Brass Foundry Co., Pittsburgh, recently was damaged by fire.

The foundry of the Millinocket Machine Co. Millinocket, Me., recently was damaged by fire.

The Quakertown Stove Works, Quakertown, Pa., plans to build a warehouse, 44 x 150 feet.

The National Brake & Electric Co., Milwaukee, will build a foundry addition, 166 x 180 feet

The Davenport Machine & Foundry Co., Davenport, Iowa, will erect a foundry and machine shop

The Ervin Foundry & Mfg. Co., Adrian, Mich., contemplates the erection of additions to its plant

The Superior Steel Castings Co., Benton Harbor, Mich., is reported planning the erection of two plants.

The W. J. Reese Brass Foundry Co., Keokuk, Iowa, contemplates the erection of a foundry building.

The Davitt Iron Foundry, Springfield, Mass., contemplates the erection of a foundry building, 55 x 105 feet.

The American Car & Foundry Co., Huntington, W. Va., contemplates the erection of an extension to its plant.

The Altenberg Tire & Equipment Co., Davenport, Iowa, contemplates the erection of a foundry and machine shop.

The plant of the Seymour Mfg. Co. recently was purchased by the Farrell Foundry & Machine Co., Ansonia, Conn.

The Landlan Foundry Co., South Haven, Mich., recently purchased a site on which it plans the erection of a plant.

The Atlas Brass Foundry Co., 981 South Front street, Columbus, O., has completed the erection of an addition to its plant.

The Johnson Bronze Co., New Castle, Pa., plans the erection of an addition to its plant to house a foundry and machine shop.

The Weir Stove Co., Taunton, Mass., is erecting an addition to its plant to replace an antiquated structure now in use.

Capitalized at $5000, the B. & S. Foundry Co., New York, recently was chartered by V. E. Bietry, 162 Morris avenue, and others.

The Liberty Foundry Co., 1831 Centerline street, Detroit, contemplates the erection of an addition to its foundry, 24 feet. 150 feet

The Dundee Foundry Co., Dundee, Mich., recently was incorporated with a capital stock of $25,000, by John B. Haynes and others.

Fast steel is being erected for the new $150,000 addition to the plant of the Anderson Foundry & Machine Works, Anderson, Ind.

Capitalized at $15,000, the Ypsilanti Motor Castings Co., Ypsilanti, Mich., recently was incorporated by J. C. Pell and others.

The Dayton Malleable Iron Co., Dayton, O., is erecting a 2-story, 85 x 111-foot plant building at Ironton, O. on South Third street

Repairs are being made to the plant of the Foundry Mfg. Co., Inc., St. Albans, Vt., which was recently slightly damaged by fire.

The Standard Foundry Co., Racine, Wis., has contracted for the erection of a shipping room and office building, to be 34 x 90 feet.

Carhart Bros. Foundry, Syracuse, N. Y., recently was incorporated with a capital stock of $75,000, by H. A., T. H. and G. C. Carhart

Erection of a foundry building, 35 x 40 feet, with a wing, 10 x 35 feet, is contemplated by the Bridgeport Brass Foundry, Bridgeport, Conn.

The Buffalo Brass Casting Corp., Buffalo, recently was chartered with a capital stock of $50,000, by J. and G. Popp, and C. Rosenberger.

The Frazer & Jones Co., Milton avenue, Solvay, N. Y., has had plans prepared for the erection of an addition to its foundry, 60 x 100 feet.

Capitalized at $30,000, the North Attelboro Foundry Co., North Attleboro, Mass., recently was incorporated by J. L. Thompson and others.

The Euclid Foundry Co., Cleveland, is expected to start shortly on the erection of its plant. The company was organized several months ago.

The Howard Heater Co., 1015 Murphy street, Des Moines, Iowa, has awarded a contract for the erection of a foundry addition, 150 x 300 feet.

The Majestic Bronze Co., New York, recently was incorporated with a capital stock of $12,000, by H. G'nsberg, 210 Canal street, and others.

Capitalized at $50,000, the Carroll Foundry & Machine Tool Co., Bucyrus, O., recently was incorporated by T. L. Sidlo, B. W. Jacobi, W. J. Monahan, J. C. Hostetler and M. G. O'Brien.

Operations in the new Ryan Bohn Foundry Co., Lansing, Mich., are expected to be started shortly. Erection of the plant is nearing completion.

The Portland Foundry Co., Augusta, Me., recently was incorporated with a capital stock of $512,500, by D. A. Leland, W. T. Gardiner and C. L. Andrews.

The Haywood Foundry Co., Indianapolis, recently was chartered with a capital stock of $150,000, by M. E. Haywood, A. H. C. Cromley and Harry Farris.

The Richmond Hill Foundry, New York, recently was chartered with a capital stock of $5000, by J. M. O'Shea, 189 Montague street Brooklyn, N. Y., and others.

Contracts have been awarded by the New Haven Stove Repair Co., New Haven, Conn., for the erection of a plant, 24 x 103 feet, with a wing 12 x 24 feet.

The Kelley Foundry & Machine Co., Elkins, W. Va., recently was incorporated with a capital stock of $25,000, by Samuel T. Spears, C. H. Hall and S. H. Watring.

The Pioneer Brass Works, Indianapolis, contemplates the erection of a foundry, 150 x 150 feet. Charles Brossman, Merchants Bank building, is architect in charge.

The Carroll Castings Co., East Chicago, Ind., recently was incorporated with a capital stock of $250,000, by Leo F. Carroll, Hugh E. Carroll and Markwood W. Coursey.

The Charles D. Hevenor Co., Buffalo, recently was incorporated with a capital stock of $100,000, to make machines, parts and castings, by H. M. and J. H. Frotheringham and others.

The American Car & Foundry Co., Chicago, has bought an additional tract in connection with its already large holdings, and it is said the site will be utilized for plant extensions.

The Boston Brass Co., Inc., Boston, recently was incorporated with a capital stock of $100,000, by Joseph A. Maynard, George H. Maynard and Raymond P. Maynard, Chelsea, Mass.

Neemes Bros., Troy, N. Y., recently was incorporated with a cap'tal stock of $125,000, to manu-

facture castings, by O. G. and C. M. Neemes and G. N. Reese, 69 West Fiftieth street, New York.

The Champion Foundry Co., Piqua, O., is erecting three factory units, each 80 x 112 feet.

The A. J. Lindemann & Hoverson Co., Milwaukee, manufacturer of stoves, etc., plans the erection of an addition to its plant, 60 x 82 feet. Klug & Smith, Mack building, Milwaukee, are architects in charge.

The Case Plow Works, Mead street, Racine, Wis. plans the erection of an addition to its plant, to be 123 x 138 feet. Foltz & Brand, 111 West Washington street, Chicago, are engineers in charge of the project.

The foundry at the American Car & Foundry Co.'s Terre Haute, Ind., plant, which has been idle for eight years, will be placed in operation shortly. The plant will be engaged in making automobile castings.

The Westport Brass Foundry, Inc., Westport, Conn., is erecting a small plant The company was recently incorporated with a capital stock of $25,000, by J. Klein, 1862 Second street, Bridgeport, Conn., and others.

The new plant of the Talladega Pipe & Foundry Co., Talladega, Ala., has started operations. Fifty men are employed and this number will be increased to 200. Sanitary pipe will be manufactured R. T. Hicks is in charge of operations.

Data, catalogs and information regarding foundry equipment are desired by the Owego Foundry & Machine Co., Owego, N. Y The company plans to build a frame addition to its plant, 36 x 78 feet, so that it can be extended readily to 78 x 108 feet when necessary. Pierre Duvinage is proprietor.

The Walker-Stuart Foundry Corp., Meriden, Conn., has been incorporated with a capital stock of $50,000, by Victor E. Walker, Amos Doolittle, John Roach, Henry Bradshaw and William Stewart, Torrington, Conn. It has leased the foundry of the Thomson Drop Forge Co., Plantsville, Conn, and will make special castings. Operation will be started shortly.

O. R. Allerton and W E. Allerton, of the Allerton Pattern Works, Benton Harbor, Mich, will head a new company soon to be organized. These interests have purchased a 60 x 100-foot plant which it is expected will be utilized as a foundry

The Bryan Pattern & Machine Co, Bryan, O, has opened its new plant, which takes the place of one damaged by fire several months ago

The Modern Foundry & Machinery Co., Minneapolis, is to erect a new plant at Hiawatha avenue and Thirty second street The foundry, which will be 78 x 140 feet, and be of steel and concrete construction, will have a 10-ton daily capacity of light gray iron castings A 50 x 80-foot machine shop will be operated. All modern equipment will be installed and operations conducted on modern lines.

A new iron foundry which will specialize in the production of soil pipe, fittings and castings of a similar nature, will be established at Kenosha, Wis, by a new company known as the Kenosha Foundry Co., which has been incorporated with a capital stock of $100,000. O. A. Arneson is head of the organization. Others interested are: Frank J. Farnam, N. J. Werner and F J. Kraft. A new foundry building will be erected according to present plans.

The Olney Foundry Co., Philadelphia, recently incorporated with a capital stock of $600,000 has purchased the plant of the Fairmount Foundry Co All the stock of the new company is controlled by the Link-Belt Co., Chicago, for which it plans to manufacture castings, according to advices from H. H. Cook, secretary. Officers of the company are: President, Charles Piez, and vice president, S. B. Peck. The principal office of the company is at 180 West Duncannon avenue, Philadelphia.

Purchased by C. F. Droseski, D. A. Droseski and F. T. Kennedy of the Saginaw Malleable Iron Co., Saginaw, Mich., the plant formerly known as the Franklin Park Foundry Co., Franklin Park, Chicago, will be operated as the Central Malleable Castings Co. The plant consists of a malleable iron foundry, 72 x 432 feet, in which two 12-ton air furnaces are installed, and which have a capacity of 450 tons of malleable castings monthly. A gray iron foundry, 72 x 160 feet, with a monthly capacity of 300 tons is also included.

Enlargement of the agricultural implement works of the Van Brunt Mfg. Co., Horicon, Wis., is being put under way. The company plans to expend $150,000 in new buildings and equipment, and the most important item of new construction will be the erection of an addition to the foundry, which will double the plant's capacity. The addition will be 80 x 200 feet. In addition to this structure a forge shop addition, 50 x 120 feet will be built as will a storage building, 40 x 150 feet. F. H. Clausen is president and general manager of the company.

New Trade Publications

SAND CUTTER. The American Foundry Equipment Co, New York, is circulating a small folder containing a list of users of its automatic sand cutter.

PHOTOGRAPHIC LENSES.—Bausch & Lomb Optical Co, Rochester, N. Y., has published an illustrated booklet in which photographic lenses are described and illustrated

CUTTING TORCHES.—Emphasizing the use and economy of light, portable, automatic cutting torches the Davis Bournonville Co, Jersey City, N. J., recently has issued a bulletin featured with 11 half-page illustrations demonstrating the different phases in the use of their torch.

GRINDING WHEELS—A discussion of the balancing of wheels for precision grinding is to be found in a booklet prepared by the Norton Co, Worcester, Mass., in addition to explanations and enumerations of the benefits from proper balancing there are illustrations of the methods to be followed.

AUTOMATIC SCALES.—The American Kron Scale Co., New York, has published a 62-page illustrated booklet in which weighing equipment for ware houses, factories, transportation companies, etc., is described and illustrated in detail These scales are of all metal construction and substantially built. Specifications and other data are given.

OIL BURNERS—A 4-page leaflet is being circulated by Alldays & Onions, Ltd., Birmingham, England, in which general information is given on the application of oil burners to stationary, locomotive and marine boilers of all types. According to the leaflet these burners can be fitted to practically every type of boiler. Some interesting data and a number of illustrations, including a diagrammatic drawing are given.

BUILDING CONSTRUCTION.—An attractive pamphlet in which an illustration placed on the left hand page is alternated with an industrial sermonette located on the right hand page has been prepared by Frank D. Chase, Inc, Chicago. The topics for the sermonettes taken from familiar proverbs and maxims are written so as to contain engineering advice and information which applies to general business development and engineering service.

PORTABLE CONVEYORS General information on portable conveyors is a part of the contents of a bulletin of recent date, issued by the Portable Machinery Co., Passaic, N. J. Power machines, with or without motors, conveyors, belts, lifting and lowering devices, transportation and other details of conveyors are discussed. Among the full page illustrations demonstrating different uses are diagrams showing the sizes of belt widths, length of conveyors, weights and horsepowers.

ROTARY COMPRESSOR.—The Jackson Compressor Co., Inc., Denver, Colo., is circulating an 8-page illustrated booklet in which it describes and illustrates rotary air compressors. These compressors, according to the booklet are simply constructed, having only five moving parts necessary to compress air and a like number of parts making up the cylinder and base. They are light weight and small in size for their capacities. Specifications and other details are given.

CRUCIBLES.—The Ross-Tacony Crucible Co., Tacony, Philadelphia, has published a 22-page illustrated booklet in which crucibles of various types and sizes are described and illustrated. These include brass crucibles, steel crucibles, phosphorizers, retorts, stirrers, skimmers, and special crucibles. A number of the illustrations show various parts of the company's plant and the last few pages of the booklet are devoted to instructions as to the care in handling and the use of crucibles.

HEATING AND VENTILATING.—The fan system of heating, ventilating and humidifying, adaptable for use in public buildings, schools, industrial plants, etc., is described in a 116-page illustrated booklet recently published by the Buffalo Forge Co., Buffalo. In this booklet stress is laid on the principles underlying the various steps in the determination of suitable apparatus to meet all conditions of heating, ventilating and humidifying. The data given are supplemented by charts, illustrations, tables, etc.

AUTOMATIC FURNACES—Automatic and semi-automatic furnaces for continuous heat treatment is the subject of a bulletin recently published by W. S Rockwell Co., New York. Illustrations are shown both of the charging and discharging ends of different types of automatic furnaces including those used for heat treating crankshafts, hardening, tempering and annealing. Quenching tanks and rotary furnaces for annealing bolts, rivets and cups are also shown. Under the discussions, general descriptions of heat treating, furnace installation and other subjects are given.

THERMIT WELDING.—The Metal & Thermit Corp., New York, has issued a revised edition of its pamphlet "Laboratory Experiments with the Thermit Process of Welding." This pamphlet is said to be useful as a guide to students in acquainting them with the substance, its characteristics and the results obtained through its use. Various experiments are described and illustrated, which are intended to show the speed of the reaction, the heat produced and the effects obtained by the superheated liquid slag and the superheated liquid steel.

PNEUMATIC TOOLS.—The Keller Pneumatic Tool Co., Grand Haven, Mich., has issued its catalog No. 5. This is a handsome book, carrying illustrations, descriptions and specifications of their pneumatic riveting, chipping and scaling hammers, jam riveters, holders-on, staybolt riveters, rivet busters, sand rammers, valveless and corliss valve drills and grinders, rivet sets, chisel blanks, hose, etc. An item of particular interest describes a riveting hammer that is a considerable departure from the hammers known by pneumatic tool users up to this time.

PORTABLE FLOOR CRANES.—The Canton Foundry & Machine Co., Canton, O., has published a 34-page illustrated booklet, in which portable floor cranes and hoists are described and illustrated. In operation these portable hoists raise the load with a lifting crank, which is on the gear shaft and which can be locked at any point by pawl and ratchet. The yoke rests on an eccentric axle, and the axle can be thrown back by raising the handle against the arm, and the weight of the machine is then shifted and rests on the front wheels. When the handle is pulled down the axle lifts the weight from the wheels and the entire load is carried by yoke. Other details and data are given.

The FOUNDRY

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Continuous Shop Is Highly Efficient

Among the Advantages To Be Derived from This Type of Foundry Are Increased Tonnage from a Given Floor Space and a Limited Flask Equipment

BY PAT DWYER

CONTINUOUS foundries are by no means an innovation although the recent demand for high production has tended to develop this type of plant design. Opinions have differed as to the real value of continuous molding and pouring, but it is significant that there has been no instance of a foundry using this system, whether erected originally for that purpose, or adapted, which has ever abandoned this method in favor of the old practice whereby all pouring was done at the close of each day. It is true that some classes of equipment which have been installed with the view to permitting continuous operation have been changed. However, the fundamental principles involved have been so universally successful that at the present time a trend toward continuous operation may be noted. In the great majority of foundries now employing continuous molding and pouring, the system was introduced after the plant had been in operation and it had become necessary to attain a greater production from a fixed floor space, although some few plants have been built entirely new, modeled upon the principles of design which earlier continuous foundries have evolved.

One of the earliest pioneers to utilize this mode of operation was the Westinghouse Air Brake Co., Wilmerding, Pa. This company's continuous foundry has been in operation for 30 years and has served as an example for many shops which have been built since. A

FIG. 1—LOOKING DOWN ON CONVEYOR TABLE IN A CONTINUOUS SHOP—THE BATTERY OF PNEUMATIC MOLDING MACHINES AND SAND HOPPERS ARE SHOWN AT THE RIGHT

considerable part of the equipment installed at that time still is doing duty. Individual parts that have worn out have been replaced from time to time, but the ideas underlying the original installation have proved their worth and remain unchanged. That the equipment functions properly may be demonstrated by the company's records which show that castings are produced in the continuous shop at a lower cost per pound than in any of the other foundries operated by the same interest.

In making this comparison it must be realized that no miscellaneous work is made in the contiunous shop. The patterns employed are for standard parts for the company's product and it is not necessary to change patterns except at infrequent intervals. Men working on piece work on the same job day in and day out become exceedingly proficient and this factor materially increases the daily output while tending to lower the percentage of defective castings. The equipment was installed by the present general foundry superintendent of the Westinghouse Air Brake Co., Samuel D. Sleeth, who recently completed 50 years continuous service with that company.

The Westinghouse company has found it profitable to operate several foundries in different localities, producing a different class of castings in each. Miscellaneous work is made in one, heavy castings in another, light castings in a third, and medium and light castings which run into thousands and sometimes hundreds of thousands on each order are made in a fourth foundry. This latter plant at Wilmerding is equipped with conveyors and other appliances which make it a continuous molding and pouring shop in every sense. Some time ago when labor was plentiful, the company ran a day and night turn, employing 1100 men in this one shop and charged as high as 420 tons of iron a day. At present only one shift is employed and that not fully manned. The daily charge at present is about 150 tons, distributed between two cupolas. The shop comprises four units all under one roof but operating independently of each other with the exception that the two cupolas each supply iron for pouring the molds in two units.

Castings are made ranging in weight from a few ounces to several hundred pounds. They are graded approximately by size into four general classes and each class is handled in one of the four units already mentioned. The largest and heaviest castings are made in the first unit, the medium weight in the second and so on to the lightest which are made in the fourth and last unit. Each division mentioned is served by a continuous conveying system which handles the molds from the time they are made, through the coring, closing, pouring, incipient cooling and shaking out operations. The conveyors are in effect traveling tables which are laid out in a modified race track form as illustrated in Fig. 7.

Each of the four traveling tables is 120 feet long, and completes a revolution in 21 minutes and each has a carrying capacity varying with the sizes of the flasks which are used. As many as 200 small flasks can be poured at each revolution of one of these units, which estimated roughly, means that it is possible to handle 4500 molds a day on this floor. The number of larger flasks handled is proportionately smaller.

FIG. 2—TABLE SHOWING ROLLER DETAILS AT THE TURN—NOTE THE AMPLE LIGHT AFFORDED BY THE ROOF

The driving mechanism for each table consists of a 30-horsepower Westinghouse motor belted to a countershaft running parallel to the line of table travel. A belt from the countershaft drives a pulley on a shaft running under the floor and terminating in a worm which in turn transmits its energy through a worm wheel keyed on the same shaft as a large sprocket wheel. As the sprocket wheel revolves the teeth engage in the cast steel links of the conveyor table. The conveyor consists of a number of boards mount-

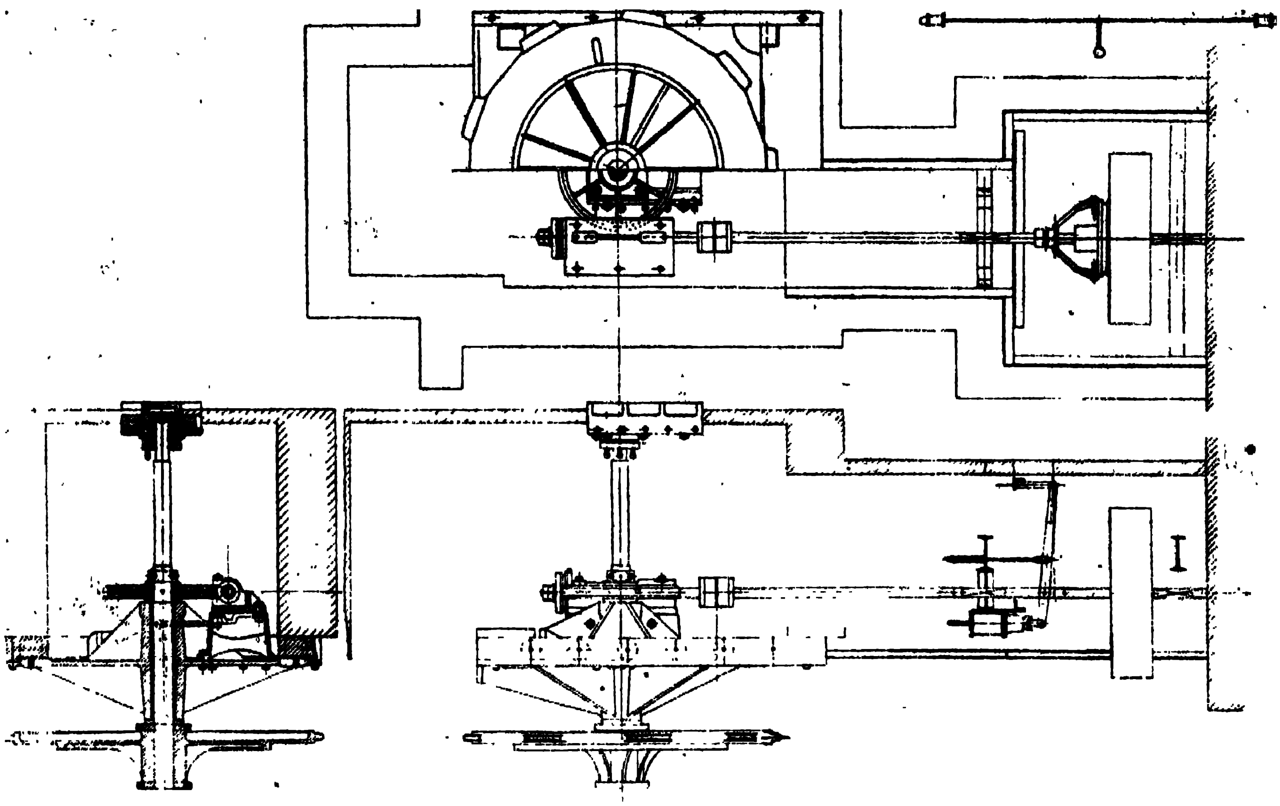


FIG. 3—DETAILS OF DRIVING MECHANISM USED IN THE OPERATION OF THE CONTINUOUS POURING TABLES

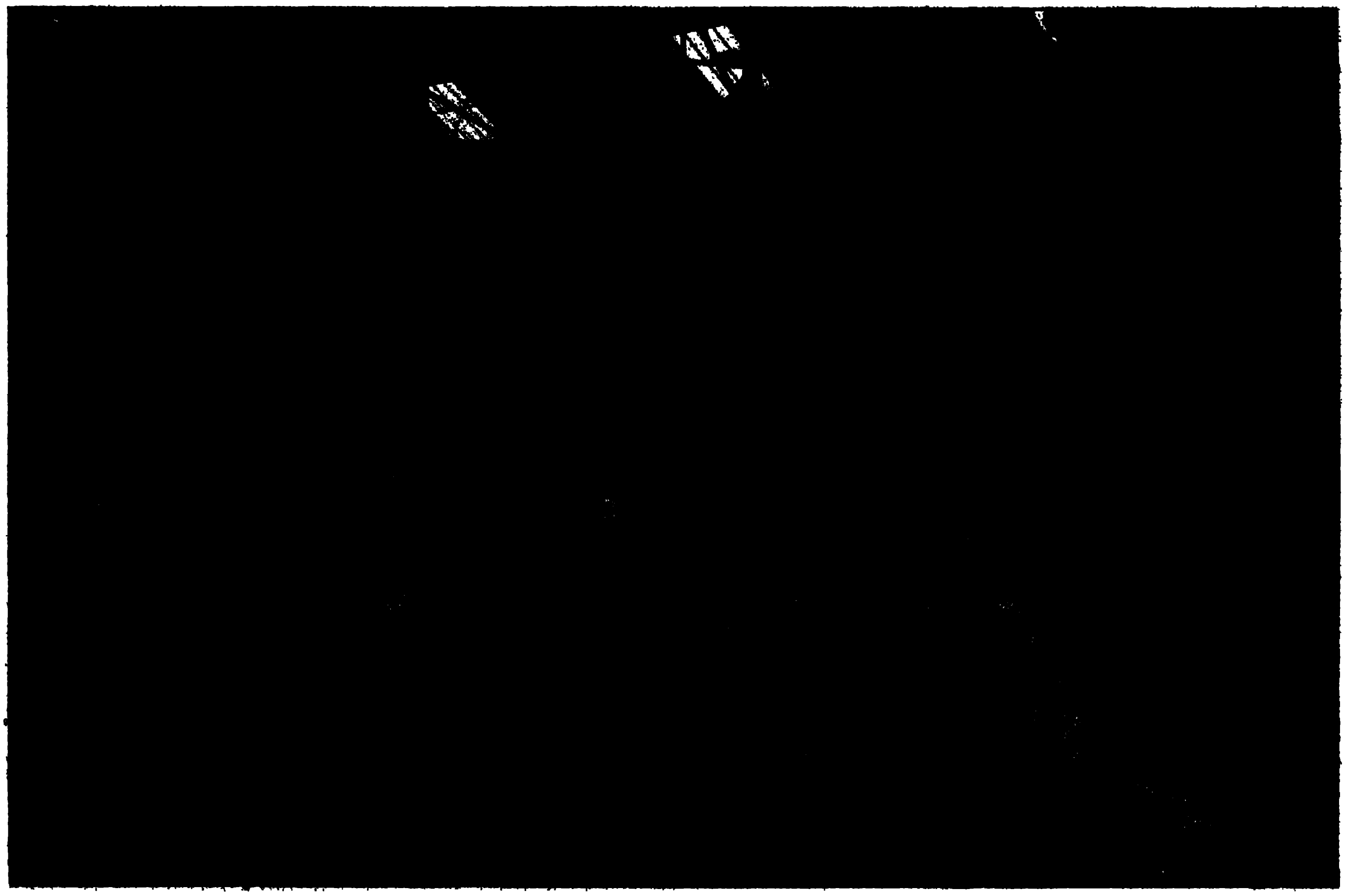
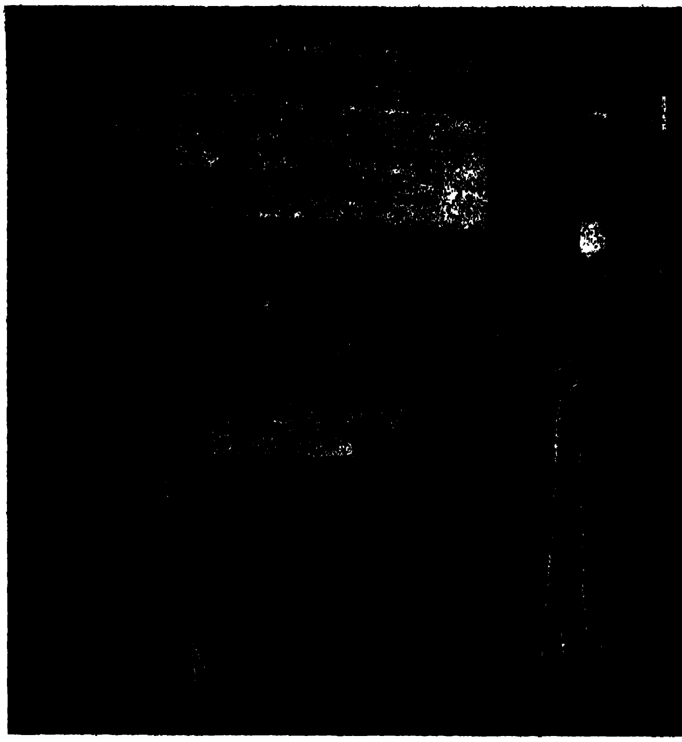


FIG. 4—THE FLASKS ARE SHAKEN OUT OVER A GRATING AND PLACED BACK ON THE CONVEYOR—THE SAND IS WET DOWN THROUGH THE RAILED OPENING SHOWN IN THE CENTER OF THE ILLUSTRATION AND THEN CARRIED BY THE BUCKET ELEVATOR ON THE LEFT TO A TROUGH WHICH DISTRIBUTES IT TO THE DIFFERENT MOLDING MACHINES



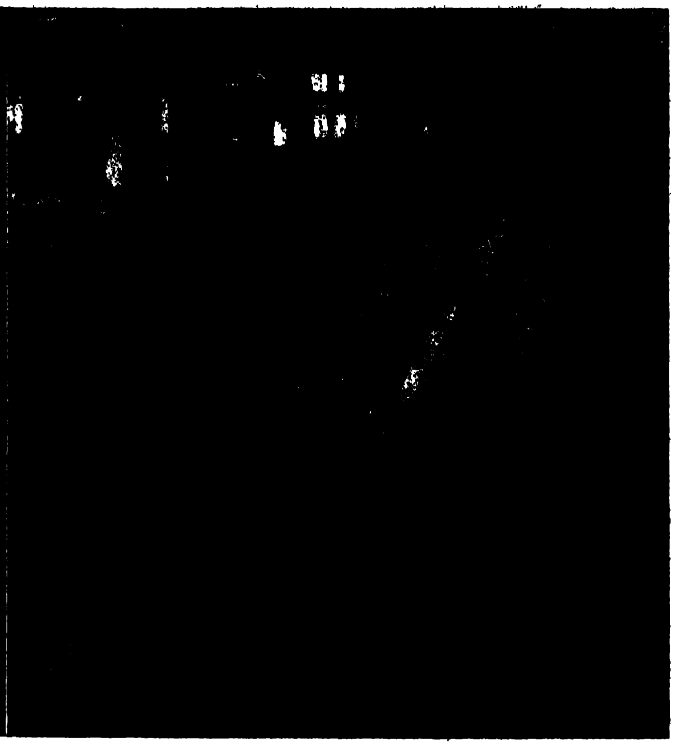


FIG. THE CLEANING BARRELS ARE ALL PROVIDED WITH HOODS AND DUST COLLECTORS FIG. 6—CLOSE UP VIEW OF ONE OF THE OVERHEAD RECIPROCATING SAND CONVEYORS

ed on a light steel frame work attached to cast-iron rollers on each side which travel on rails. The links under the table are formed of alternate steel castings attached by suitable lugs to the bottom of the conveyor frame and provided on the bottom with cavities which engage the teeth on the driving sprocket wheel; and links made of flat pieces 3 x ½-inch steel plates joined at the ends by ¾-inch pins which fit loosely to allow for freedom of movement.

The pulley at the driving end of the shaft is provided with a clutch coupling and by throwing this clutch out it is possible to stop the travel of the table at any time it may be necessary to do so.

The tables are raised about 2 feet above the floor level. Each consists of three parts, an outside stationary wooden platform on which the men stand or walk when closing or pouring the molds, a center section mounted on a conveyor belt or more properly speaking a steel frame, and a third section, also planked over, which occupies the space within the center of the oval trackway. The illustration Fig. 7 will make the meaning clearer. In this illustration the platform is shown by itself with all the other details omitted and the purpose of each section designated. The point at which the castings are shaken out together with the appliances for doing the work are shown in Fig. 4. A description of the method pursued and the sequence of operations at one of these platforms with some minor modifications for the class of castings handled at each, will serve for all four units.

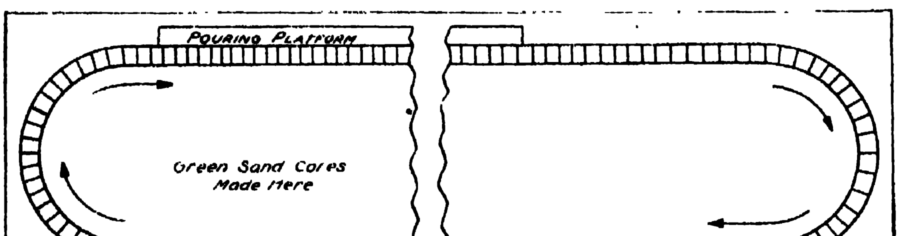


FIG. 7—GENERAL ARRANGEMENT OF CONVEYOR TABLE

A battery of molding machines is situated near the center of one side, separated from the platform by a 6-foot gangway. Consider a typical job, an air brake cylinder for railroad cars. Drags are rammed on six machines and copes on six others. The patterns are mounted on stripping plates and when the flask is rammed the pattern is dropped clear of the mold. The drag is lifted off, rolled over and set on the conveyor.

The cores for this job are made in iron core boxes situated on the wooden platform inside the conveyor belt. Collapsible core arbors keyed by wooden wedges to central pieces of heavy 2-inch pipe are employed. The cores are made of green sand, rammed by hand. A certain amount of skill is required in ramming these cores as the lower surface must be hard enough to withstand the upward pressure of the molten iron and the top must be soft enough so that the iron will not blow or *kick* from it. The necessary skill is acquired in a short time by those without any previous foundry experience. After the cores are rammed, they are lifted out of the core boxes and placed on horses, being supported at each end by the central pipe.

Coming back now to the drag which has just been placed on the conveyor platform; two men lift one of the green-sand cores from the horses and set it in the drag. The pipe projecting from each end of the core fits into openings in the ends of the drag provided for that purpose and automatically locates the core in its proper relative position, assuring an equal thickness of metal at the ends, the sides, the top and the bottom. The conveyor is moving all the while, and after the core is set a cope which in the meantime has been rammed and lifted off the machine, is swung over and lowered onto the drag. This sequence of operations

is kept up all day. A boy standing at the upper turn of the conveyor clamps the flasks as they pass.

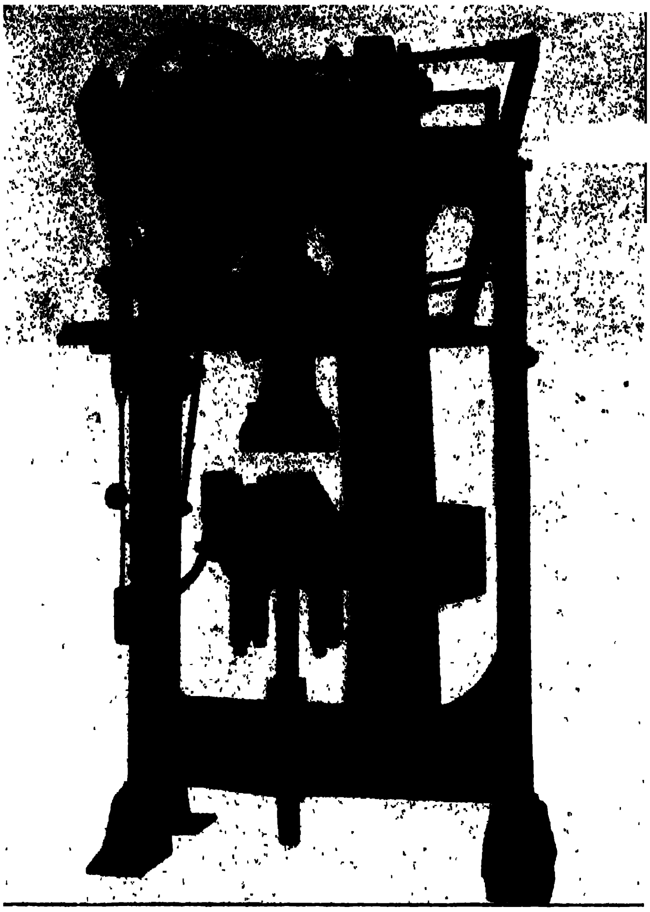
Pendant hooks suspended from a monorail extending from in front of the cupola to the pouring side of the conveyor, are employed to support the ladles used in pouring the molds. The ladles at each unit have sufficient capacity to pour several molds at each trip. They are pushed along while pouring, at a speed corresponding to the speed of the conveyor. The melting speed of the cupola also is regulated to keep a constant supply of iron at the pouring station so that the waiting line of molds does not become too long. By the time the molds have traveled the remaining length of the conveyor and rounded the turn at the lower end the castings are cold enough to shake out. A boy stationed at the lower turn knocks the clamps off the flasks as they pass.

Two hydraulic cranes are situated over the lower end of the conveyor and are attached to the flasks by suitable slings just as they come around the turn and start on the journey toward the point where they were first placed on the platform. The crane picks up the complete mold and drops it with a bump on the rails shown in the illustration Fig. 4. The cope is lifted off and if necessary given another bump on the rails. The drag is then turned over and the casting rolls down the inclined ends of the rails. From there a man with a long hook pulls it away to a cooling floor where it remains until it is cold enough to be taken and put in one of the tumbling barrels where the castings are cleaned. Before going in the tumbling barrels the core sand is rapped out and the collapsible arbor removed piece by piece through the small openings in the ends of the casting.

After the sand has been bumped out, the cope and drag are set on the conveyor which carries them to a point in front of the molding machines. A sufficient stock of flasks is maintained at this point so that the latest arrivals have time to cool before again being placed in service. At no time do the flasks become so hot that they could not be used immediately if necessary, but allowing the flasks to cool adds to the comfort of the men, especially in the summer time.

The two heavy work units are served by a total of 24 hydraulic molding machines which were built by the company in its own shops. The action of these machines is controlled by a special intake and release valve which gives a combined squeeze and jolt pressure to the sand forming the mold. On large flasks, say 3 x 2 x 1½ feet, the plunger carrying the table which supports the flask is forced up against the squeezer plate three or four times. After each upward move, it is dropped back quickly, thus jolting the sand adjacent to the pattern plate. It is claimed that this results in a more even density of sand in the flask than if it had been simply jolted from the bottom or squeezed from the top alone.

Air brake cylinders and work of a similar character are regarded by foundrymen, as fairly hazardous, requiring skilled molders and the closest supervision over the character and composition of the iron with which they are poured. The molding process at the Wilmerding plant has been so standardized that ordinary labor may be instructed in a short time to perform any of the subdivision operations into which the processes have been reduced. The castings must be clean,



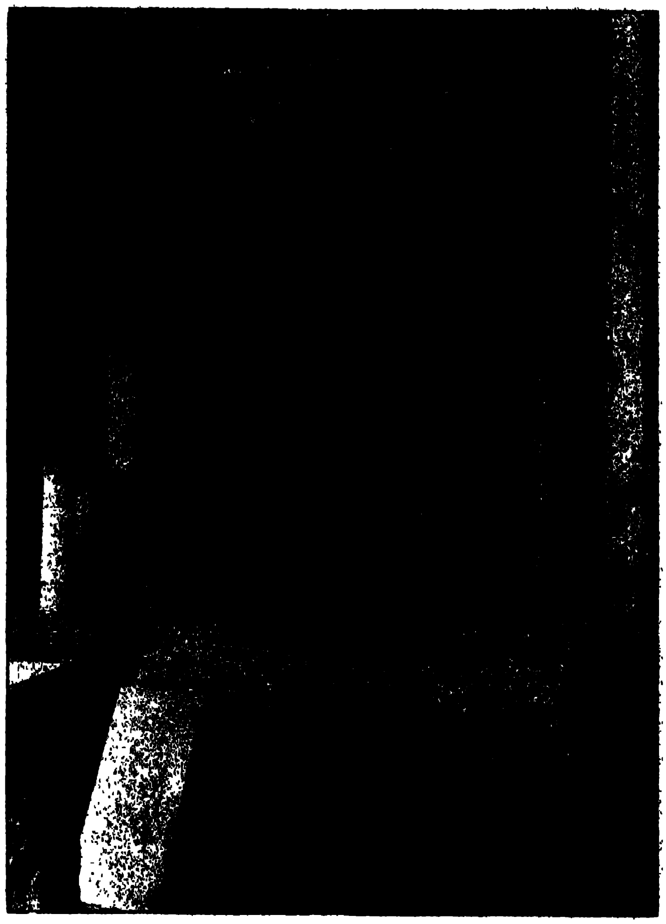


FIG. 8—CORE-MAKING MACHINE WHICH DRIVES THE SAND INTO THE CORE BOX WITH THE AID OF COMPRESSED AIR FIG. 9—THE SHELVES ON THIS CORE OVEN ARE ATTACHED TO A SPROCKET CHAIN WHICH TRAVELS APPROXIMATELY 20 FEET VERTICALLY—A GAS BURNER IS SITUATED ON THE FLOOR OF THE OVEN—ONE REVOLUTION DRIES THE CORES—THEY ARE PLACED ON THE SHELVES THROUGH ONE DOOR AND TAKEN OUT THROUGH A DOOR AT THE OPPOSITE SIDE

solid and must conform to a certain definite weight. Therefore, it is essential that no disturbance occur while the molten metal is filling the mold. Cuts, blows, scabs or porous spots due either to wet sand or hard ramming would be disastrous and are provided against by careful supervision of the sand mixing equipment and by adjusting the intensity of the stroke delivered by the molding machines. Once the machines are set to ram the sand to a given density, the human factor is eliminated and every mold is rammed to exactly the same pressure and compactness.

Use Hydraulic Machines

The hydraulic equipment, which was installed by the Morgan Engineering Co., Alliance, O., comprises an accumulator capable of withstanding a pressure of 1250 pounds per square inch; one steam pump with three ⅞-inch water pistons made by the Buffalo Pump Co., Buffalo; one steam pump with three ½-inch pistons made by the Worthington Pump Co., New York; and three electric pumps with 2⅛-inch pistons made by the Deming Pump Co., Salem, O. Twenty-four molding machines derive their power from this installation. The hydraulics were the first type of molding machines installed and this may account in some measure for the partiality of the company for this type. Another reason may lie in the fact that the machines were designed and built by the company itself, in its own shops but whatever the reason, the fact remains that these hydraulic machines are highly efficient.

The air compressor installation which serves the pneumatic molding machines at the tables where the small molds are made, is capable of delivering 4640 cubic feet of air per minute. The air supply of course also is available in the cleaning room and for some special machines in the core room. Iron flasks are used exclusively and while those used on two of the tables are light enough to be moved by hand, those on the other two tables are entirely too heavy to be handled in that manner.

The principal difference between the operation of the light and heavy floors is in the manner of shaking out the molds. In the former, a man is stationed near the conveyor a short distance from the pouring stand and as the molds pass he slips the end of a long steel bar between the drag and the bottom board. By jerking down sharply on the outer end of the bar and using the edge of the conveyor as a fulcrum he is enabled effectually to loosen the complete mold. A second man stationed a little farther along lifts the empty flask and sets it further back on the conveyor and with a long hook he jerks the casting from the conveyor to the floor. The castings are stacked in a huge pile and allowed to cool before being taken to the cleaning room.

When the flasks are shaken out the sand falls through a grating similar to that shown in Fig. 4, onto a wide moving belt. A man seated by the railed enclosure manipulates a hose and sprinkles the sand as it passes by below him. The belt discharges into a pocket from which a bucket elevator, also shown in the same illustration, carries the sand and drops it into a long trough which extends over the hoppers serving the different molding machines. A reciprocating type sand conveyor, the details of which are shown in Fig. 6, is used for moving and mixing the sand. The scrapers on the conveyor are hung from hinges which enables them to swing freely on the back stroke, but a suitable stop at the back holds them rigid when the conveyor is moving ahead. The conveyors are driven by individual Westinghouse motors, the rotary motion being converted into reciprocating by a belt and counter shaft, and a suitable crank connection. As a further proof that the flasks do not become hot on their passage from the pouring stand to the shaking-out floor, it is stated that the sand is only 20 minutes in transit between the shaking out screen and the molding machines and yet no trouble is experienced from its being too hot. New sand is added at regular intervals. This is thrown through the screen where the flasks are shaken out and thus has a chance to become thoroughly incorporated with the old sand before it finally reaches the molding machines.

The castings are tumbled in a battery of barrels of different sizes but all conforming to the general features of the one shown in Fig. 5. Owing to the bulky character of most of the material to be handled, the staves are extra strong and substantial. An interesting feature in connection with these tumbling barrels is the dust collecting hood which encloses each one. The body of the hood is formed of thin plate; but the door which slides up and down in front is made of wood fitted into an agle-iron frame. Each hood is provided with a 6-inch opening at the top through which the dust is drawn by a suitable fan and system of piping leading to several dust arresters while the mill is in operation. After the castings are cleaned they are removed from the barrels and whatever chipping is necessary is attended to in a space set apart for that purpose at one end of the foundry. They are then ready for shipment to one of the company's numerous machine shops.

The core room is situated upstairs in a building adjacent to and opening directly into the foundry. The lower floor is occupied by a general store room, a locker and wash room. In addition to the regular methods of making and drying cores consisting of hand rammed coreboxes and drawer-type horizontal ovens, there is in operation, and has been for several years, a vertical core oven which dries the cores in one revolution, and a core making machine made by William Demmler & Bros., Kewanee, Ill., which employs compressed air to shoot the sand into the box and pack it there. This latter machine is exceedingly fast, being capable of making eight complete cores a minute and has a wide range of adjustment. It makes cores from 1 inch to 14 inches in length and will fill boxes requiring as much as 200 cubic inches of sand. It is provided with a sand elevating and feeding device which insures a proper quantity to suit the core that is being made. It is claimed that cores made on this machine are naturally vented, the theory being that the surplus air escaping from the core immediately after the box is filled leaves the core porous yet firm and strong. Cores may be made of sharp sand, loam sand or green sand and any binder may be used except flour, which must be used sparingly. For sharp-sand cores the machine operates satisfactorily at 80 or 90 pounds pressure, but loam-sand mixtures require from 100 to 115 pounds pressure.

The cupola platform is provided with several tracks and the coke and iron is shunted by a locomotive crane in carload lots from the stock yard. On the platform the pig iron charges are made up on buggies which are weighed and afterward pushed close to the charging doors where the material is charged by hand. The scrap is charged through an upper door by means of a buggy which is lifted on an hydraulic hoist and tipped when it reaches the door.

Under New Management

The Northern Iron & Steel Co., Chicago, recently has taken over the Beckemeyer Foundry Co., Beckemeyer, Ill., and will operate it as the Beckemeyer foundry branch of the Northern Iron & Steel Co. The plant consists of a gray iron foundry and pattern shop.

The Eastern Foundry Co., Jamesburg, N. J., which recently changed management, is producing piano plate for the market. Thomas Watts, Matawan, N. J., is president of the company, and Harry Bolt, formerly with the Matawan Iron & Steel Co., is in charge of operating.

Fabricating Steel Foundry Flasks

Rigidity Is Obtained by Forming Ribs on 3-Inch Centers — Bottom Half of Each Rib Is Made Shallow to Provide a Shoulder Upon Which the Sand Rests — Diversified Uses of Flasks

BY J. D. KNOX

CONCURRENTLY with the development of mass production in the automotive industry came a transformation in the methods of manufacturing the various parts which comprise the complete motor car. These changes affected practically all processes, including that of producing castings. Foundrymen who previously had received orders involving hundreds of castings from a single pattern were compelled by the demands of automobile builders to seek equipment suited for the economical production of thousands of identical castings.

The new requirements were met by adopting machine molding on a more extensive scale and by employing more durable patterns and molding flasks. Cast and pressed steel came into widespread use and at the present time practically all of the engine castings and most of the other cast parts of automobiles are poured in metal flasks. Because of their lightness, rigidity and durability, pressed steel flasks are being used for molding automobile pistons, flywheels, truck wheels, rear axle housings, tractor parts, etc.

Among the companies which recently have engaged in the manufacture of steel flasks is the Truscon Steel Co., Youngstown, O. Stock from which the flasks are made is copper-bearing, open-hearth, medium blue annealed plates, 60 x 100 inches. It is rolled by outside mills in thicknesses of 5/32, 3/16, 7/32 and 1/4 inch. Upon delivery to the Truscon plant the steel is piled in a warehouse, which is built at right angles to the building housing the pressed steel department. An electrically driven shear, equipped with an adjustable stop gage on the back table, is built at the end of the warehouse nearest the pressing department. The plates are taken from the stock pile as required, and transferred to the shear.

FIG. 1—FLASK, WEIGHING 87 POUNDS, USED EXTENSIVELY IN MALLEABLE FOUNDRIES

After the cut is made the blanks are piled on a steel platform and taken to a large press in the forming department where the first operation is performed. This consists of stamping one or more ribs on 3-inch centers according to specifications. Sections 3 inches high are made with one rib, sections 6 inches high with two ribs, etc. Where a section is built with two or more ribs, the latter are pressed in the metal one at a time in order to avoid stretching the steel. The top half of each rib is made with a steep slope in order that the sand will slide in position easily when the flask is placed in service; the bottom half of each rib is made shallow and acts as a shoulder, upon which the sand rests.

To provide a place for clamping the cope to the drag and to permit the ramming of sand without interference, the practice followed by the company is to turn the top flange of the cope and the bottom flange of the drag outward and the sand strips inward. Some users, however, desire both flanges turned inward. After the flanges have been formed the next operation is to turn the corners. Before this can be done, however, it is necessary to anneal the steel at the place where the bend is to be made in order to relieve the hardness introduced to the steel during the forming operation. The steel is removed from the flanging press, placed on the floor and the flanges heated with an oxygen-acetylene gas flame. The die used for turning the corners is of the built-up type and affords the stamping of any number of ribs of any width. Round flasks are formed in a similar manner

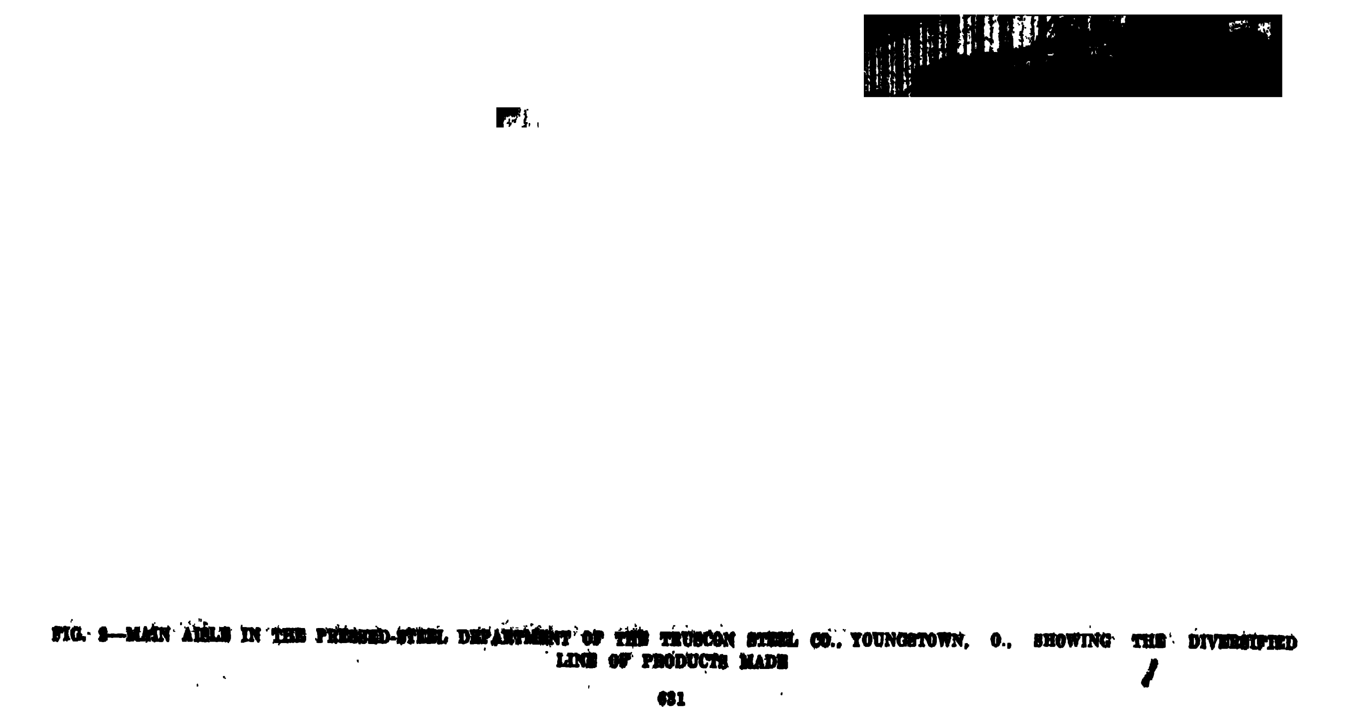
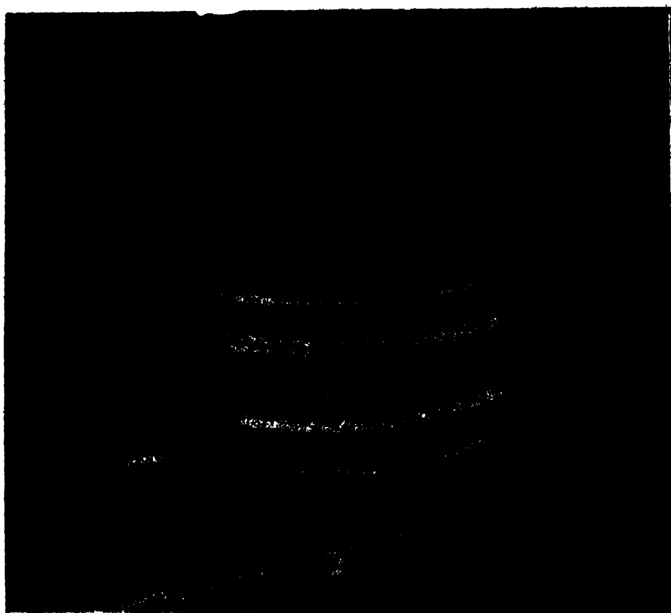
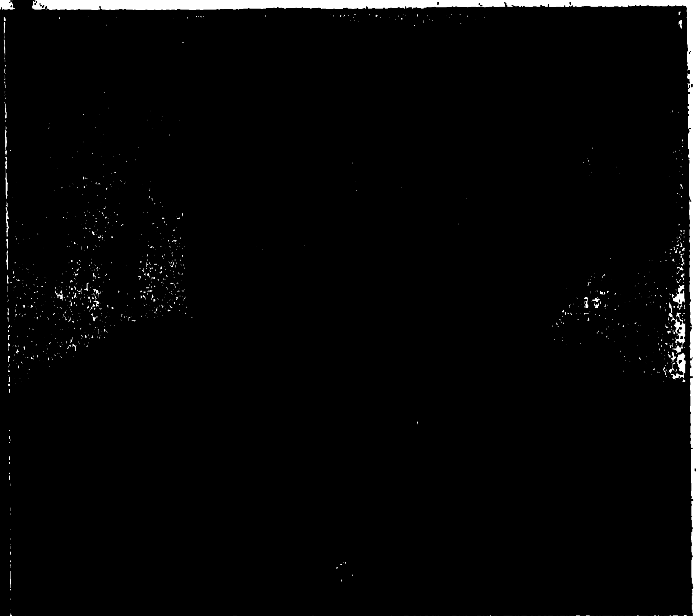
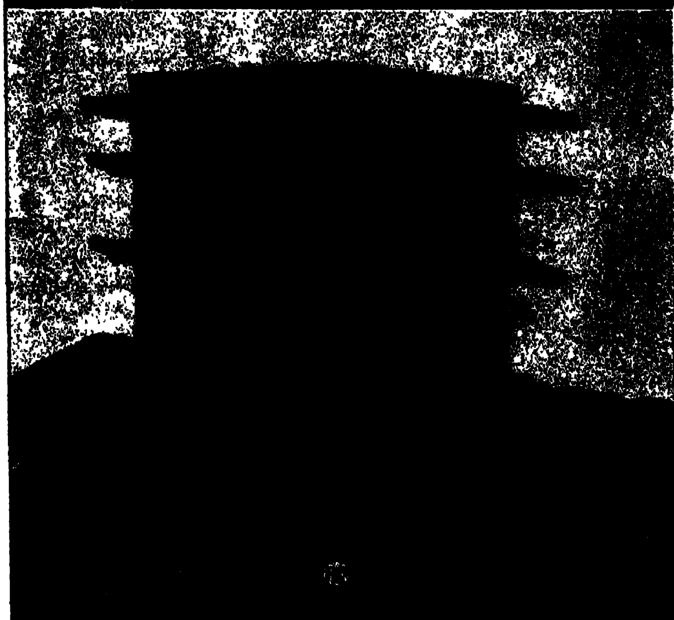
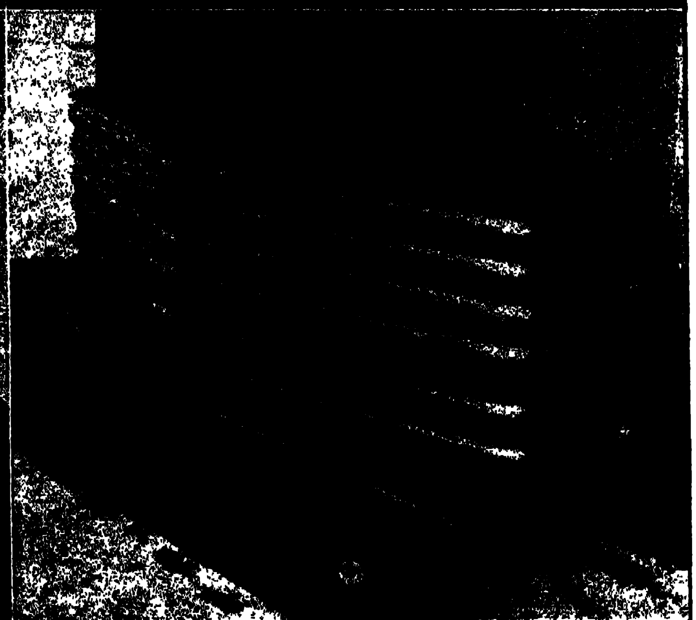


FIG. 2—MAIN AISLE IN THE PRESSED-STEEL DEPARTMENT OF THE TRUSCON STEEL CO., YOUNGSTOWN, O., SHOWING THE DIVERSIFIED LINE OF PRODUCTS MADE









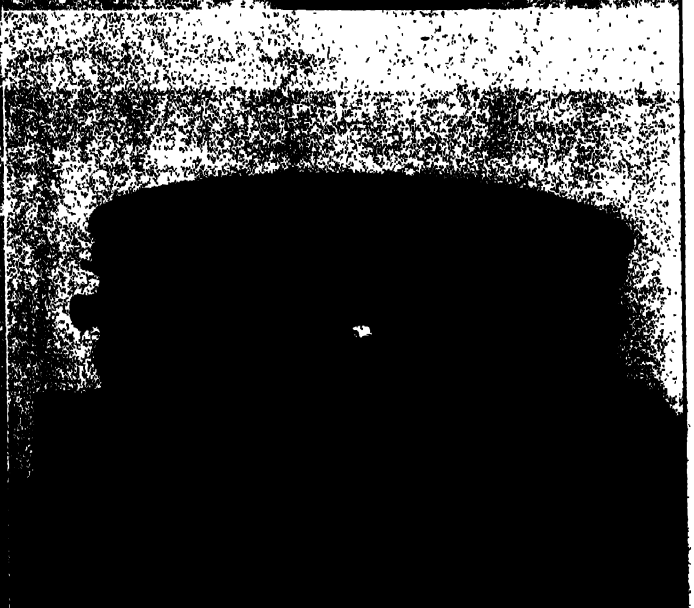


FIG. 3—CIRCULAR-TYPE FLASK ILLUSTRATING TYPICAL BARRING CONSTRUCTION FIG. 4—WHEN FLASKS OF THIS TYPE ARE [illegible] WITH TRUNNIONS, PIPE SOCKETS ARE USED INSTEAD OF HANDLES FIG. 5—FLASKS OF THIS TYPE ARE USED FOR MISCELLANEOUS WORK, AND ARE PROVIDED WITH DOWEL-PIN BRACKETS SO THEY CAN BE BUILT UP TO ANY DESIRED DEPTH FIG. 6—FLASK USED FOR CASTING REAR AXLE HOUSINGS FOR TRUCKS FIG. 7—FLASK USED FOR CASTING TRACTOR PARTS FIG. 8—CIRCULAR FLASK, WEIGHING 208 POUNDS, USED FOR CASTING TRUCK WHEELS

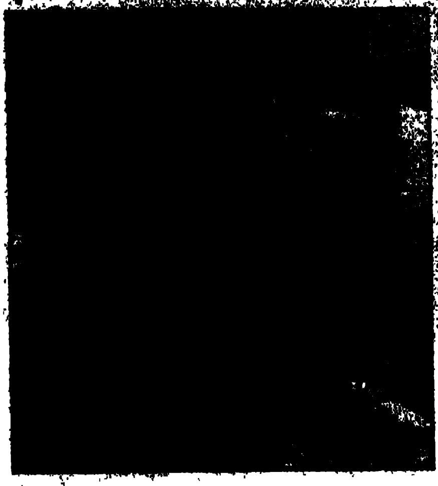


FIG. 9—PRESSED-STEEL BOX AND PLATFORM USED FOR HANDLING SMALL PARTS

as the square types with the exception that the built-up die strikes each half section three or four times while only one stroke is required to round the corners of the square flasks.

After the corners are rounded the shells are inspected, matched, and taken to assembly benches where two sections are clamped together to form the flask. In this condition they are transferred to the welding shop which is housed in a separate building off the pressing department. The welding department is equipped with eight electric welding machines, these being operated in individual compartments. At this stage in the process of manufacture only the inside seams are welded. The flasks then are taken to the drill presses where four holes are drilled in the center of each end for the dowel brackets and four additional holes near the rounded corners for the handle and handle bracket. The dowels, which are made of malleable iron, then are drilled and the whole taken to the riveting department where the handles and brackets are attached with 3/16-inch rivets driven hot. Gas muffle furnaces are used for heating the rivets.

The stock then is returned to the welding department for welding the cross bars in place. Prior to this step, however, the bars are lined up by a jig. Certain foundrymen order their flasks with the bars welded on one side and riveted on the other. Ordinarily the bars are welded in place. Several types of flasks, particularly those of heavy construction, are equipped with trunnions, which are formed from 2-inch steel pipe with collared ends. A heavy ring is welded in the center of each trunnion to form a second collar and the whole welded to the sides of the flask. Malleable-iron trunnions originally were used but when shipments of the castings became difficult, officials endeavored to find a substitute. A flask was equipped with welded steel trunnions and after being loaded with two tons of steel, the whole was lifted by a crane, the trunnions bearing the entire weight. As no deflection of the trunnions or walls of the flask was noticed the test was carried further by hammering with a heavy

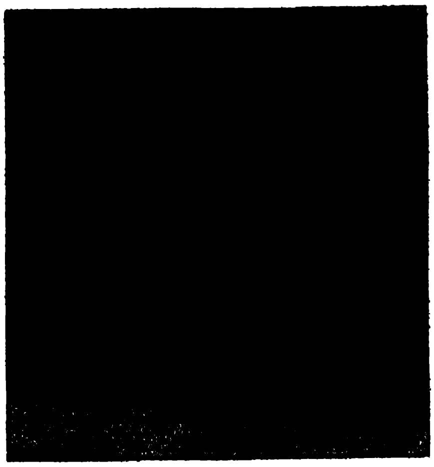


FIG. 11—CIRCULAR-TYPE FLASK, 17 INCHES DIAMETER, USED IN MAKING AUTOMOBILE FLYWHEELS

sledge. Numerous blows failed to break the trunnions at the weld although they did cause the trunnions to break a short distance away. Four short steel pipes, 1-inch in diameter, are welded to the corners of the flasks equipped with trunnions to afford easy handling. In preparing these handles they first are heated to the desired temperature in a gas-fired muffle-type furnace, and then taken to a small press, which flattens and grooves one end. The grooved end is welded to the side of the flask, the open end of the pipe forming the handle.

After any excess metal due to the welding process is ground off, the flasks are transferred to a table where by means of jigs the dowel pin holes are accurately drilled. The holes then are reamed. At the beginning of the fabricating process the flasks are made 1/8-inch higher than specifications, in order to provide enough leeway for

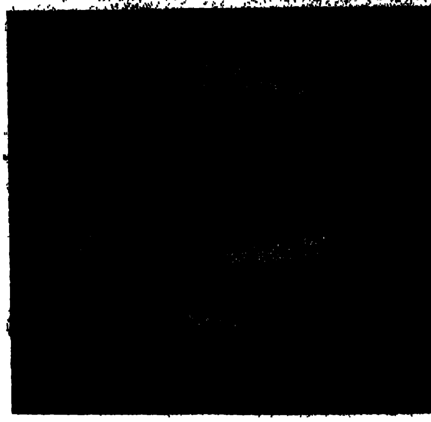


FIG. 12—COPE, 4¾ INCHES, AND DRAG, 8 INCHES, BOTH WEIGHING 45 POUNDS USED FOR MAKING AUTOMOBILE FLYWHEELS

flattening upon completion of the work. The final pressing of the flask to make it conform to specifications removes any twists and leaves the sand strips smooth. Any dents in the sand strip, which the press fails to remove, are eliminated by hammering when the flasks arrive at the inspection benches. After a rigid inspection the flasks are shipped.

Before any actual work is begun on the flasks, blueprints are prepared by the engineering department of the Truscon company and forwarded to the customer for his approval. Where an order embraces flasks which are to be equipped with bars, the customer usually furnishes wooden patterns together with templates, these aiding in the preparation of accurate drawings and in a more prompt completion of the order.

Fig. 6 shows a double tapered flask made from 3/8-inch plates and weighing 225 pounds. The cope is 12 inches and the drag 7 inches. Flasks of this type were built for use in casting rear axle housings for automobile trucks. The shell of the flask is drilled to receive cast-iron bars for the various types of axles made. The tapered flask shown in Fig. 13 was made for casting the dash of a tractor.

The flask shown in Fig. 1 is 19 x 19 inches inside the sand strip and includes a 4½-inch cope and a 14½-inch drag. It is made of 3/16-inch stock and

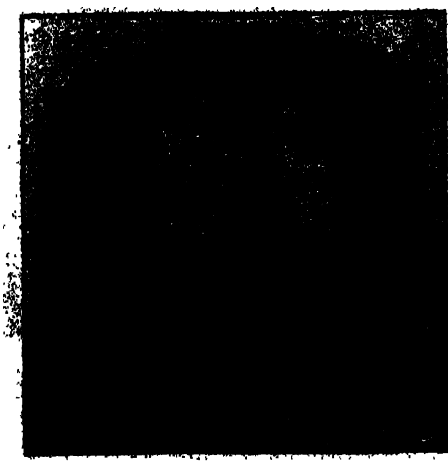


FIG. 10—FLASK, 12¼ INCHES SQUARE, USED IN MAKING AUTOMOBILE PISTONS

FIG. 13—IRREGULAR-SHAPED FLASK, WEIGHING 120 POUNDS, USED FOR MAKING A TRACTOR DASH

weighs 87 pounds. Prior to shipment all copes were drilled for bars, which were to be cast and bolted in place by the customer. Quarter-inch plates were used in making the flask shown in Fig. 4. The total weight is 195½ pounds. The arrangement of the bars in the cope is typical of many orders received by the Truscon company. Practically all flasks equipped with trunnions have pipe sockets instead of handles welded on the cope.

The type of flask shown in Fig. 5 is used extensively by a manufacturer of electrical equipment. The size is 18 x 18 inches, the various sections being 4 and 7 inches high. Inasmuch as the flasks are used for miscellaneous work in the foundry both flanges are turned inward. In addition the flasks are provided with dowel-pin brackets at both the top and bottom in order that the flask may be built to any desired height. Fig. 7 shows a 19 x 28-inch flask with a 9-inch cope and a 3½-inch drag, which was made for a tractor company. The illustration shows the method employed for attaching the bars to the sides of flasks intended for special jobs. The cope and drag shown in Fig. 3 each are 20¾ inches diameter and 5½ inches high. Flasks of this type also are used extensively for making tractor castings.

FIG. 14—PRESSED-STEEL PLATFORMS USED IN CONJUNCTION WITH ELECTRICALLY AND HAND-OPERATED LIFT TRUCKS—THE PLATFORM IS OF ONE-PIECE CONSTRUCTION

A large number of flasks similar to the one shown in Fig. 12 are in service in plants making flywheels for automobiles. They are 17 inches diameter and include a 4½-inch cope and a 3-inch drag, the whole weighing 45 pounds. The flask shown in Fig. 8 was made for casting truck wheels. It is 36 inches diameter with an 8-inch cope and an 8-inch drag and weighs 208 pounds. The circular flask illustrated in Fig. 11 also is for making automobile flywheels. The square type flask, Fig. 10, is used for making automobile pistons.

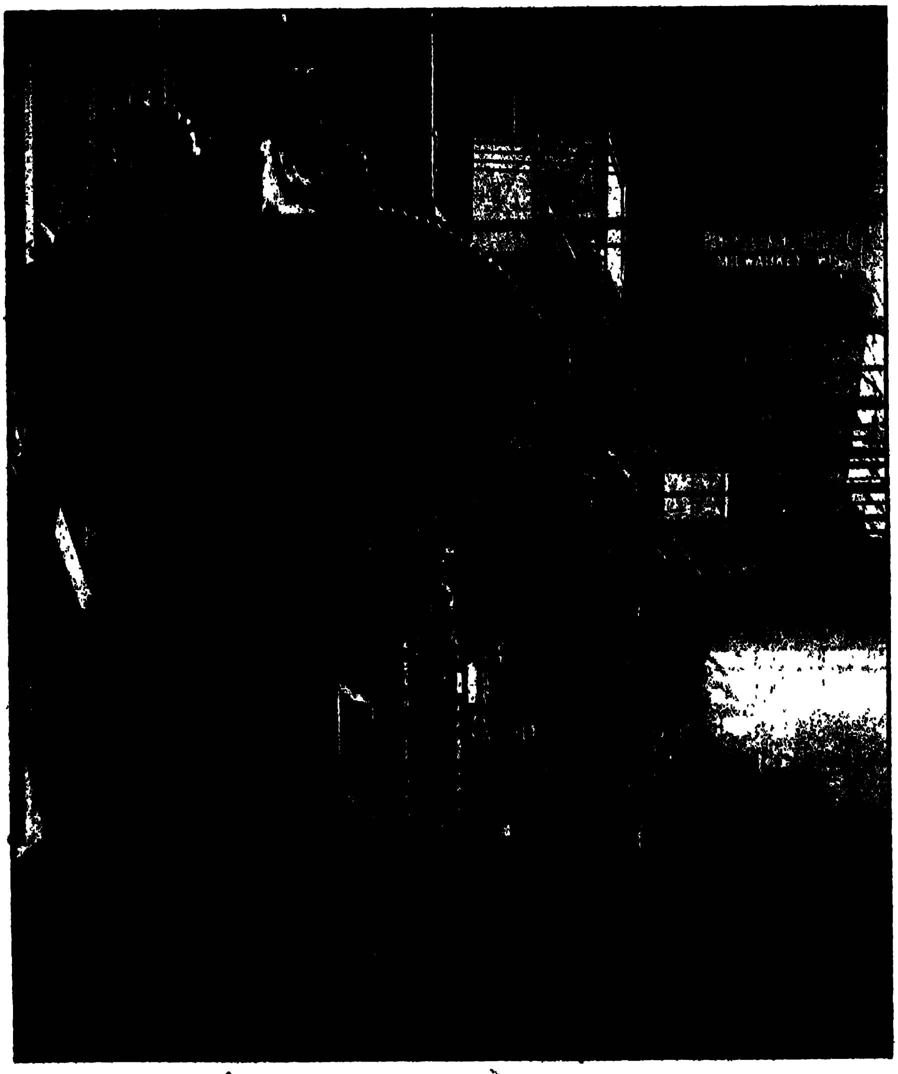


FIG. 15—A BATTERY OF HEAVY TOGGLE PRESSES INSTALLED ALONG THE LEFT-HAND SIDE OF THE PRESSED-STEEL DEPARTMENT OF THE TRUSCON STEEL CO.

Securing Low-Carbon Cast Iron

By H. E. Diller

Question—Please inform me how I can reduce the carbon in cupola iron. It now averages 3.50 per cent and I would like to reduce it to 2.70 per cent. Could I do this by adding steel to the charge in the cupola?

Answer.—There is no satisfactory way of obtaining, with regularity, low-carbon iron from the cupola. The addition of steel scrap in small quantities would not make a material difference as the steel would take up carbon from the coke in the cupola.

One foundry with which the writer was familiar used a mixture consisting of one-half 8 per cent ferrosilicon and the remainder steel scrap. The ferrosilicon contained about 2 per cent carbon and the steel scrap averaged 0.40 per cent carbon, so that the average of the charge was about 1.20 per cent carbon, as the mixture went into the cupola. When the iron came from the cupola the percentage of carbon varied greatly from one part of the heat to the other. The iron from the first of the heat would contain as high as 3 per cent carbon, while towards the last of the heat the carbon in the metal might be as low as 1.80 per cent. This low carbon did not greatly increase the strength of the metal as iron with 3 per cent of carbon was nearly as strong as that with only 1.80 per cent carbon.

The most practical method to obtain cast iron low in carbon would be to melt it in an air furnace and add any amount of steel scrap necessary. It also could be secured by adding molten steel to the iron from the cupola. This could be done by melting the steel in a separate furnace and adding it to the metal from the cupola in a ladle. By either of the two methods the amount of carbon could be controlled.

Irons for Diesel Engine Castings

The Results of an Extended Series of Experiments Point to the Fact That the Proper Iron Composition is the Most Important Factor in the Manufacture of These Prime Movers

BY F. J. COOK

CONSIDERING the fact that everyone who has had to do directly with the manufacture of diesel engines is convinced that the metallurgical side of the question is one of vital importance, it is remarkable that among the host of papers written on the subject of this type of prime movers few have made any attempt to deal with the casting problem. This paper deals only slightly with design and that only as it affects the metallurgy of the subject but concerns itself more fully with the items which are essential in the production of satisfactory castings.

The growth of cast iron due to repeated heating has been made the subject of investigation by several well known authorities and it has been proved that growth is largely due to the influence of gases which penetrate the cast iron by way of cavities formed by large graphite flakes or loosely intermixed crystals of the metal. It follows therefore that anything which favors either of these undesirable conditions is essentially detrimental to success.

The planes of crystallization in cast iron when it is passing from the molten to the solid state, group themselves perpendicularly to the surface of the external contour, that is to say at right angles to the outside surface and in the direction in which the heat of the fluid cast iron has passed outward. Every abrupt variation in the external contour of a casting, no matter how small, is attended with an equally marked sudden alteration in the arrangement of the crystals of the metal. A confused and irregular formation of crystallization occurs in the neighborhood of each such point of variation. The proper interlocking of the crystals is prevented, resulting in weak and open structures if not actual cavities. Some castings of this character, on account of the static pressure of the metal in the mold when casting, or some other cause, artificial or accidental, do not show these weaknesses in any marked degree; but when such castings are exposed to repeated heatings the crystals change position and form the same loose and confused mass, with the consequent weakening of the structure.

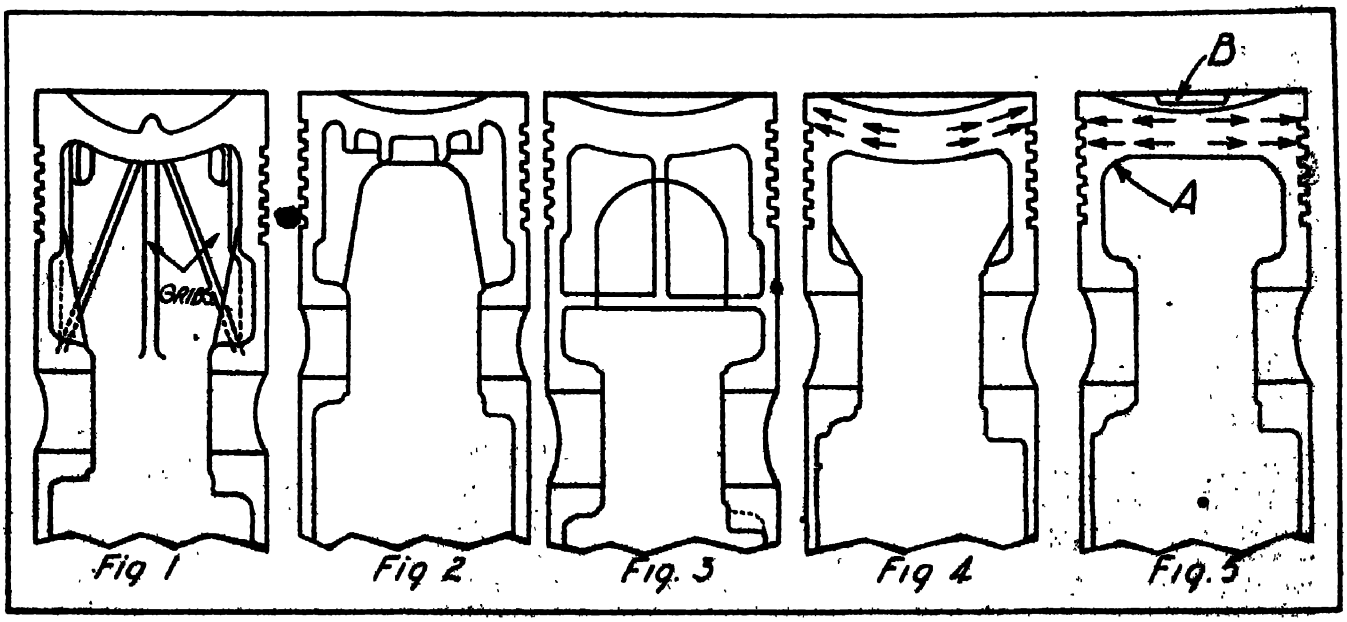
The natural remedy for the conditions outlined is to so design the casting as to avoid all sharp angles, ribs and sudden deviation of sectional outline so that the metal while being poured will flow in natural curved lines. These remarks apply to castings in general but the matter is of primary importance in the design of diesel engine pistons and cylinder heads. It is apparent that the pistons shown in Figs. 1, 2 and 3 are not only subject to the effects of bad crystallization, but also have the dis-

Abstract of paper presented by F. J. Cook, Birmingham, before the North-East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle-upon-Tyne, Jan. 30, 1920.

TABLE I

Comparative Analysis

	Suggested by Hurst Per cent	German Per cent	Another German Per cent	Continental Per cent	Replaced by Per cent	Scotch Per cent	Suggested by the author Per cent
Phosphorus ...	0.52	0.33	0.59	0.54	1.34	0.54	not over 1
Manganese ...	1.44	0.72	0.99	1.08	0.28	0.97	not over .5
Silicon	0.9	0.83	0.91	0.92	0.8	0.77	0.76–0.82
Results.......	....	good	bad	bad	good	good	Has never given star cracks, low tensile results, or bad wearing qualities.



REPRESENTATIVE TYPES OF PISTONS USED IN DIESEL ENGINE CONSTRUCTION—THE MANY RIBS AND BRACKETS IN FIGS. 1, 2, 3 AND 4 CAUSE INITIAL COOLING STRAINS AND PREVENT HOMOGENEOUS CRYSTALLIZATION—THE IDEAL DESIGN IS SHOWN IN FIG. 5

advantage of being subjected to high initial cooling strains which further increase the liability of cracking when in use. An improved design shown in Fig. 4 has been quite successful in ordinary work. A further improvement has been effected by designing the under side of the head straight as shown in Fig. 5. This type has given excellent

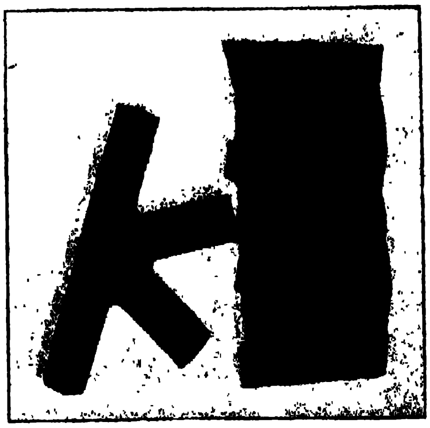


FIG. 6—TEST BAR TO DETERMINE CASTING TEMPERATURE

results during the war in submarine work. It is essential that there be a good easy angle at the point marked *A* to avoid a too abrupt change of section. An angle at the bottom of the cutaway *B* is also desirable, it will prevent a crack from starting at that point.

Every process in manufacture that facilitates closing the grain should be taken advantage of. Cylinder liners and pistons should be cast on end to get the benefit of the static pressure of the metal in the mold. Denseners have been used for improving the compactness of the piston head but their use requires special care or the castings will be too hard.

A cast-iron piston, if too hard, has a tendency to split right across when first put to work, particularly if subjected to full load soon after starting. A tough iron is therefore most desirable.

Determining Factors

Properties of cast iron essential to successful working of diesel engine pistons and liners are: High tensile and other physical traits; metal which will readily take a high polish under working conditions; and the ability to resist growth and cracking when subjected to the high working temperatures which are a feature of this class of engine. The factors which determine these conditions are: Chemical composition; casting temperature; rate of cooling; microstructure. It is essential that the rate of cooling be taken into account when considering the chemical composition of metal to be employed in any casting.

It is not too much to say that all the physical properties of the metal depend on the quantity of carbon present and its condition. The value of the other elements will be in proportion to the effect they have on carbon and the compounds it forms. Professor Turner states (Metallurgy of Iron) that maximum tensile strength is associated with 0.47 per cent combined carbon and maximum transverse strength with 0.7 per cent. The experience of the author of this paper, however, leads him to the conclusion that these figures should be reversed for present day practice; maximum tensile strength being obtained with 0.6 to 0.8 per cent and maximum transverse strength with 0.4 to 0.6 per cent, and with total carbon not exceeding 3.25 per cent.

Silicon is always present in varying proportions. The influence it exerts on the condition of the carbon present and consequently on the hardness and fluidity of the iron is marked. Since the quantity and condition of the carbon are so important and the effect of the silicon on this element, so marked, it is clear that if a formula can be adduced that will show when these two elements are in the best proportions for a given class of work, a very important stage will have been reached. With this object in view the following more or less empirical formula is presented based on the amount of carbon:

$$Sc = 4.26 - \frac{Sil}{3.6}$$

Where Sc = ratio of silicon to carbon; C = total carbon in percentage; Sil = silicon in percentage. The elements carbon and silicon are in the best proportion for diesel engine pistons and liners and all parts requiring highest tensile strength when the value of Sc = 0.76 to 0.82; and for water cooled cylinder heads and castings requiring maximum transverse strength when the value of Sc = 0.83.

The presence of sulphur makes the molten metal thick and sluggish and promotes blow holes, but this element in fair proportions, say 0.12 per cent, adds considerably to the wearing properties and strength of the metal. It is necessary, however, to cast sulphury iron as hot as possible.

There are many who think it impossible to produce strong iron unless the percentage of phosphorus is very low. To lower this element they frequently resort to hematites, but these, with their high percentage of total carbon often do more harm than a liberal dose of phosphorus. When the proportion of total carbon and silicon correspond to the formula presented earlier in this paper, the proportion of phosphorus may be as high as 1 per cent, without seriously jeopordizing the tensile strength. With steam cylinders and castings of complicated design requiring maximum strength, the reduction of shrinkage and the additional fluidity of the metal due to the high phosphorus content will result in sounder castings, with fewer initial contraction strains. Where the ratio of silicon and carbon is different from that which has been suggested the quantity of phosphorus becomes a vital factor and must then be kept as low as possible.

Table No. 1 goes to show that where the silicon and carbon are in the desired ratios, the quantity of phosphorus present does not affect the quality of the casting.

The second column gives particulars of a piston in a German made engine which has given reasonably good results. After about six months' running the pistons were found to be slightly deformed and showed signs of wear; but they would generally be classed as good. The piston in the German engine dealt with in the third column did not last six months, it was badly worn and star-cracked, but certainly not because the phosphorus was not low enough or the manganese not sufficiently high. The results derived from working the next engine described as "Continental" were bad from the first. The pistons were scrapped and new ones made from the same design. To prove the effects of phosphorus these were cast with this element as high as 1.34 per cent, but

TABLE II
Result of Annealing

Test No.		Tensile strength Pounds per square inch	Transverse strength Pounds, 1-inch square bar, 12-inch centers	Impact	Hardness
1	As cast	39,080	3976	65	77
	Annealed	30,688	3584	60	44
	As cast	37,850	3500	75	84
	Annealed	30,240	3080	50	39
	As cast	39,872	3780	70	80
	Annealed	30,844	3164	60	67

with a silico-carbon ratio to satisfy the formula. The manganese was very low, 0.28 per cent. These pistons are still giving excellent results. The pistons of the type dealt with in the sixth column and described as "Scotch" have also given excellent results.

Manganese has a tendency to harden the metal both directly and by causing the carbon to remain in the combined form. The general properties of the metal, other than a tendency to chill, are not materially affected so long as the manganese is not in greater proportion than 0.7 per cent. If denseners are used on the face of the castings it is not advisable to have the managanese over 0.4 per cent.

The proportions of the various elements found to give good results for diesel engine pistons and liners are: Total carbon, 3 to 3.2 per cent; silicon, 1 to 1.20 per cent; phosphorus, not over 1 per cent; manganese, not over 0.50 per cent; sulphur, 0.12 per cent. For cylinder covers which do not require to be so hard and in which metal with less contraction is desired, the silicon can be increased to 1.50 per cent and the manganese to 1 per cent. The most advantageous amount of steel to be added to the metal is about 15 per cent.

Considering the enormous heat which the pistons and cylinder heads have to withstand it is imperative that everything in the nature of cooling strains in the castings should be eliminated Heat treatment of cast iron at low temperatures affects the physical properties of the metal and a prolonged treatment at 780 Cent. is positively dangerous. The results of annealing on the physical properties of a few out of many test bars is shown in Table II.

The tensile test bars were cast 1½-inch diameter, turned down after annealing to ½-inch area in the center before testing. The transverse bars were cast 1¼-inch square, machined to 1-inch square and tested on 12-inch centers. Deterioration of a serious nature, as shown in table III was caused by exposing them to the action of a coal fire flame. The alterations in the chemical composition of the same bars were: Total carbon reduced from 3.16 per cent to 3.02 per cent; sulphur increased from 0.112 per cent to 0.17 per cent; silicon decreased from 1.58 to 1.30 per cent.

For the guidance of founders, two useful workshop tests, with the class of iron suggested are: Impact test and casting temperature. The sections of diesel engine parts are very thick, particularly the piston heads and it is advisable to test the metal under nearly similar conditions.

A satisfactory test is on bars 40 millimeters square (1.57 inches) supported on knife edges 160 millimeters (6.3 inches) apart, and by dropping a weight of 12 kilometers (26.5 pounds) from a height of 30 centimeters (11.8 inches), increasing the height of drop by increments of 5 centimeters (1.9 inches), until the sample breaks, the height of drop at which the bar eventually fractures being taken as the impact figure. Attached to the weight, in such a manner as to strike the bar parallel to the supporting knife edges, and at the center, is another knife edge. The face of each knife edge should be rounded $\frac{1}{16}$-inch radius for bearing surface. A result of 55 centimeters (21.5 inches) is considered none too high for this class of work, although this is quite a severe test.

Low silicon and low carbon cast iron are susceptible to the effects of casting temperature, and some irons employed for such purposes are also liable to liquid contraction. A handy workshop test for casting temperature with this class of iron, consists in making bars of the general dimensions shown in Fig. 6. When cold, the bars are broken through the line *A-B*, the condition of the fracture giving an indication of the temperature at which the metal was poured. Passing from the correct temperature (which is usually as hot as can be obtained from the cupola) to a low one, the following fractures will be observed. Perfectly solid and homogeneous; then slight whitish center; then brown centers of varying sizes and depth of color, as temperature is lowered, and then black center. With the latter are always associated open cavities, and immediately above each cavity is invariably found a gas hole. A set of results showing various casting temperatures is shown in Fig. 7.

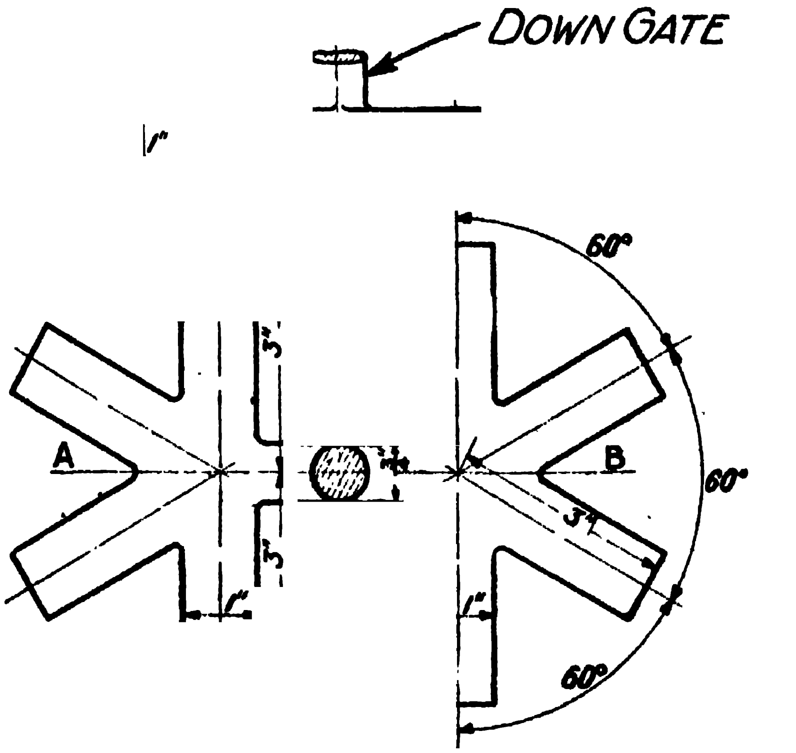


FIG. 7—SHOWING THE RESULT OF POURING THE SAME COMPOSITION OF IRON AT VARYING TEMPERATURES

TABLE III

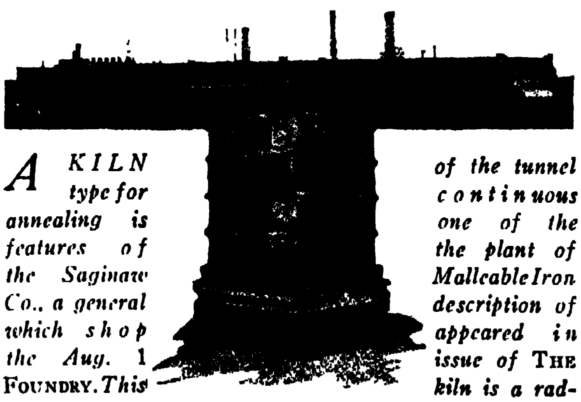
Result of Exposure to Coal Fire Flame

Test No.		Tensile strength Pounds per square inch	Transverse strength Pounds, 1-inch square bar, 12-inch centers	Impact	Hardness
4	As cast	38,752	3802	75	82
	Annealed	34,697	3752	55	67
5	As cast	30,872	3584	70	78
	Annealed	32,256	3444	60	110

Anneal Malleable in Tunnel Kiln

Castings Put in Pots Without Packing Material—Time from Entrance into Furnace to Exit is 120 Hours—Many Pyrometer Couples Determine Temperature Throughout the Furnace

BY H. E. DILLER



A KILN of the tunnel type for continuous annealing is one of the features of the plant of the Saginaw Malleable Iron Co., a general description of which shop appeared in the Aug. 1 issue of THE FOUNDRY. *This kiln is a radical departure in the method of annealing and while its full advantages have not yet been determined, it has been in operation long enough to show certain tendencies and indicate what advantages may be expected from its operation. The construction and operation of the kiln are described in this article from information supplied by the Saginaw company. An article on the method of time study used by this company will appear in a later issue.*

WHILE innovations are constantly being made in the metal casting industry, the great majority of them are so slight that the change brought about by their introduction is not generally noticed. Many minor developments in the course of time change the methods of production by easy stages, but there is an occasional radical departure from general practice which is marked.

Malleable castings have been annealed on the same general plan almost since the beginning of the industry. That is to say they have been packed in pots with an oxidizing scale and loaded into large ovens which are cooled each time to slightly above room temperature and again heated with the charge. Improvements have been made from time to time in the design of the ovens, in the method of packing the pots, in the apparatus employed for charging the pots, and in the method for firing. However, the general plan of packing the pots in a comparatively cool oven, heating the charge to the required temperature and cooling in the oven to well below the red heat after the castings have been soaked at the maximum temperature for a designated length of time, is practiced at practically all malleable foundries. This process leaves plenty of room for improvement. The length of time required is excessive, the weight to be handled is about doubled by the packing, and a large amount of heat is wasted by cooling and reheating the oven each cycle. Experiments have shown that an oxidizing packing is not as essential as had been thought and some foundries have adopted sand for packing, while a few have dispensed with all packing for some classes of castings. However, the length of a cycle, which is usually from 6 to 8 days has not been appreciably lessened although experimental tests have shown that it is possible to anneal a casting in 40 hours or less and get fair results.

Recently the tunnel kiln has been introduced for annealing malleable iron, one of these kilns having been installed at the plant of the Saginaw Malleable Iron Co., Saginaw, Mich. This kiln was installed by the American Dressler Tunnel Kilns, Inc., New York, under the direction of D. A. Drozeski, who furnished the heating curve for which the kiln was designed. While it is entirely new to the malleable iron industry, similar kilns long have been in use for firing porcelain and more recently for annealing steel. The main difference in the kilns used in the porcelain industry and in the one in service at the Saginaw foundry is the heavier charge which must be carried in the malleable foundry. Otherwise the requirements influencing the design of the kilns is quite similar.

In the operation of the kiln, castings are packed into pots without packing material. The pots are placed on cars which are charged into the furnace through an antechamber at regular intervals. The cars travel through the kiln in an opposite direction from that in which the gases of combustion are moving, although these gases do not come in direct contact with the cars or their charge. The cars continue on through the firing zone where they attain the maximum temperature. They then pass to a portion of the kiln which is not heated except as to the walls and roof absorb heat from the hot pots. While passing through this zone the charge is gradually cooled. When the furnace is filled, a car passes out the rear and every time a new one is charged into the kiln. This outgoing car first enters an antechamber from which it is drawn after the door between the antechamber and the main portion of the kiln is closed to prevent the admission of air into the kiln. The charge comes from the kiln too hot to be handled, so it is placed under a pipe through which air is blown on the hot charge until the next car comes from the oven. After the charge is cool enough to handle, the pots are dumped. A description of the construction of the kiln will aid in understanding the detailed process of annealing. A plan of the kiln is shown at the top in Fig. 1. This indicates the location of the burners on one side of the furnace. A duplicate set of burners is placed directly opposite to those marked. The cars enter at the left and travel in the direction indicated by the arrow. A cross section of the furnace is shown in the lower left-hand corner of Fig. 1. The combustion chambers A, A, are formed by hollow refractory tile placed against each other, make a duct through which the burned gases are carried to the exhaust. As the ducts are hollow with openings at both the lower and upper inside portions the gases of the kiln chamber enter the lower portion of the hollow tile, are heated by contact with the walls and so rise through both the front and back leg of the tile, passing out through the apertures at the top. This action produces a constant circulation of heated gas in the kiln so that the temperature is practically the

same at the top as at the bottom of the kiln. The proper mixtures of refractories for the tile at the different portions of the kiln have been determined by the Dressler company through many years of experience with porcelain burning kilns. Carborundum has been adopted for the tile at the hottest portion of the kiln. A layer of powdered silicious material is placed over the top of the furnace to conserve the heat.

The one end of the combustion chamber is at the exhaust and the other end, which is closed, is at the electrical equipment on the kiln a duplicate set is provided as insurance against accident or breakage.

A pair of fans also is used on each side of the kiln and at each end to draw air through pipes located in close proximity to the wheels of the cars which pass through the kiln. These pipes extend from both ends on each side to the middle of the kiln. They serve to prevent the temperature of the wheels from going above 700 degrees Fahr. Two fans draw the exhaust gases from the kiln through preheaters used to give the parts of the furnace. These are connected to an indicating instrument by four selective switches. Readings are taken every hour and marked on cards. The readings from each couple are placed on a separate card. Fig. 11 shows a portion of the cards on the rack to the right, while the indicating instrument is illustrated to the left above the four selective switches. Air volume and pressure gages may be seen towards the center of the illustration. The pyrometer equipment was installed by the Brown Instrument Co., Philadelphia. Calibra-

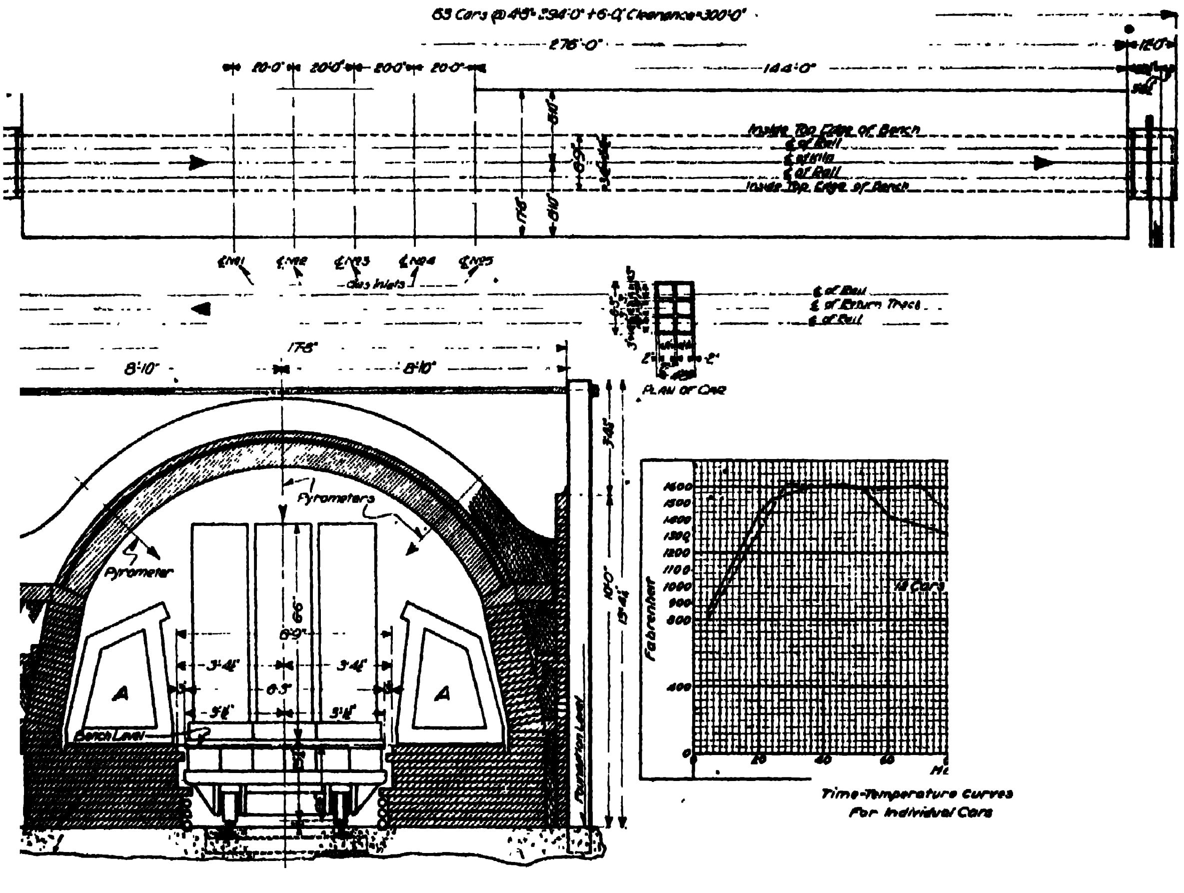


FIG. 1—ABOVE THE PLAN OF A CONTINUOUS ANNEALING TUNNEL KILN—TO THE LEFT, BELOW, A CROSS SECTION OF THE KILN—THE CHAMBER IS HEATED BY TE BURNING GASES WHICH PASS THROUGH THE FLUES *AA*—TIME TEMPERATURE CURVES ARE SHOWN BELOW, TO THE RIGHT—THESE CURVES VARY ACCORDING TO THE RATE AT WHICH THE CARS ARE CHARGED INTO THE KILN

end of the firing zone fartherest removed from the entrance of the kiln. Next to the combustion chamber there is a similar chamber which extends to the exit end of the kiln. This chamber acts oppositely from the combustion chamber, being adapted for carying off the heat and thus cooling the pots more rapidly than they otherwise would be cooled. A pair of fans is provided on both sides near the exit end of the kiln, for drawing cool air through these ducts. However, so far the pots have cooled rapidly enough without the aid of the fans. Only one of each pair of fans would be required at a time to draw air through these ducts but like all air blast an initial heat before it enters the combustion chamber. Another pair of fans blows the air for combustion through the burners. The kiln has 14 burners, 7 on each side. These burners vaporize oil which is taken to the burners under 12 pounds pressure, but drips from the oil pipe and is blown by air at a pressure of ¼ pound. A carbon dioxide recorder made by the Foxboro Co., Foxboro, Mass., is used to determine whether the mixture of oil and air is correct to give complete combustion without an excess of air.

The temperature of the oven is watched carefully by the aid of 44 pyrometer couples located at different tion of the instrument and couple is made regularly to insure correct readings.

The operation of the kiln may best be understood by the help of illustrations. Fig. 3 illustrates the loading of the pots. Wooden trays are placed on a gravity roller conveyor, a base made of white iron is then put on the tray and a pot is set on this. Following, a white-iron plate is used for three pots instead of the bottom stand casting. This makes a complete stack. The base supports have short feet as may be noted in the one to the right of the center column, Fig. 3, while the plates are flat and serve to prevent the weight of castings in the

FIG. 2—BEFORE THE CARS ARE PLACED IN THE KILN CARE IS TAKEN TO SEE THAT NO PART OF THE CAR OR OF THE CHARGE WILL STRIKE THE SIDES OR ROOF OF THE FURNACE—THE CAST-IRON BOTTOM PLATE WHICH WAS EXPANDED BY THE TEMPERATURE IS BEING REPLACED BY STEEL

pot from bearing on those in the pot beneath.

No packing is used, the castings being put into each pot loose. One of the functions of packing material is to prevent warping, and it has been found that a few designs of castings have a tendency to warp when annealed without packing material. Some such castings were annealed in the ovens of the standard type. Later experiments showed that all castings could be annealed in the continuous kiln. The old ovens serve to anneal the over supply of castings on peak loads and can be discontinued when the foundry is not producing to its maximum capacity.

FIG. 3—SOME CASTINGS ARE PACKED INTO THE ANNEALING POTS BY HAND, WHILE OTHERS ARE SHOVELED INTO THE POTS AS THEY PASS ALONG A GRAVITY ROLLER CONVEYOR—THE ABSENCE OF PACKING MATERIAL LIGHTENS THE CHARGE TO BE CARRIED THROUGH THE KILN

FIG. 4—CARS ENTER AN ANTECHAMBER AND ARE PUSHED FROM HERE INTO THE KILN BY AN HYDRAULIC RAM

Castings from some patterns which tend to warp are packed in the pots by hand. The two workmen to the right in Fig. 3 are engaged in packing castings by hand. The pile of castings shown towards the left of the same illustration are shoveled into the pots and the top of each pot is filled with the smallest sized castings which fill in the spaces between the larger castings.

Pots Loaded by Crane

After the pots are filled and covered they are loaded on a car by a crane and stacked four high. This operation is illustrated in Fig. 7, which shows the last pot being carried to a car. Another pot may be seen at the end of the gravity conveyor. The small castings which are nearby have not yet been shoveled into this pot. The joints between the pots are luted with a mixture of fire-clay and sand before the car is placed in the oven. The pipe swung horizontally to the left of the illustration is used for measuring the height of the stacks on the car to prevent any car from being loaded so that it will become jammed against the roof of the furnace. Another height gage is located at the end of the track leading to the entrance of the kiln. The pots are 16 x 25 inches inside and are 16 inches high. The stacks are placed on the car three abreast and two rows deep. A number of loaded cars ready to be charged in the kiln are shown in Fig. 2. The workman is chipping the sides of the cast-iron

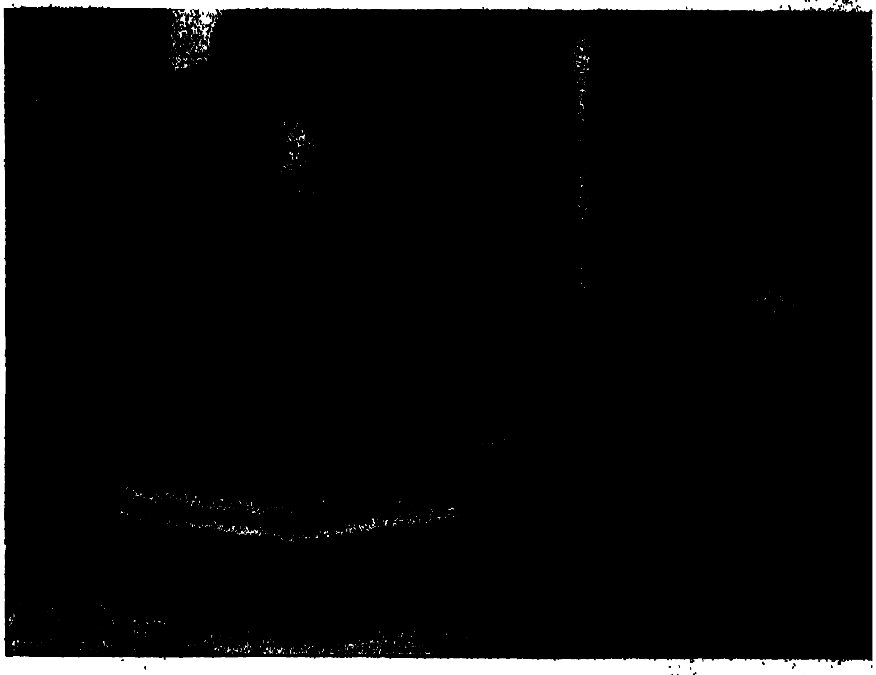


FIG. 6—AIR IS SOMETIMES BLOWN OVER POTS AFTER THEY COME FROM THE FURNACE

plates which cover the car. These plates are enlarged by the heat of the kiln and care must be taken to determine before they are put in the kiln that they are not too wide, otherwise the car would stick while being passed through the kiln. On account of this tendency of cast iron to grow under change of temperature the bottom plates will in the future be made of cast steel or a special grade of cast iron.

Huge Weight Transferred

When the weight of one of these loaded cars is considered the enormous weight which must be pushed through the kiln by the hydraulic ram will be appreciated. The car weighs approximately 3 tons, and the pots and bases on each car about 7 tons, while the castings are calculated to

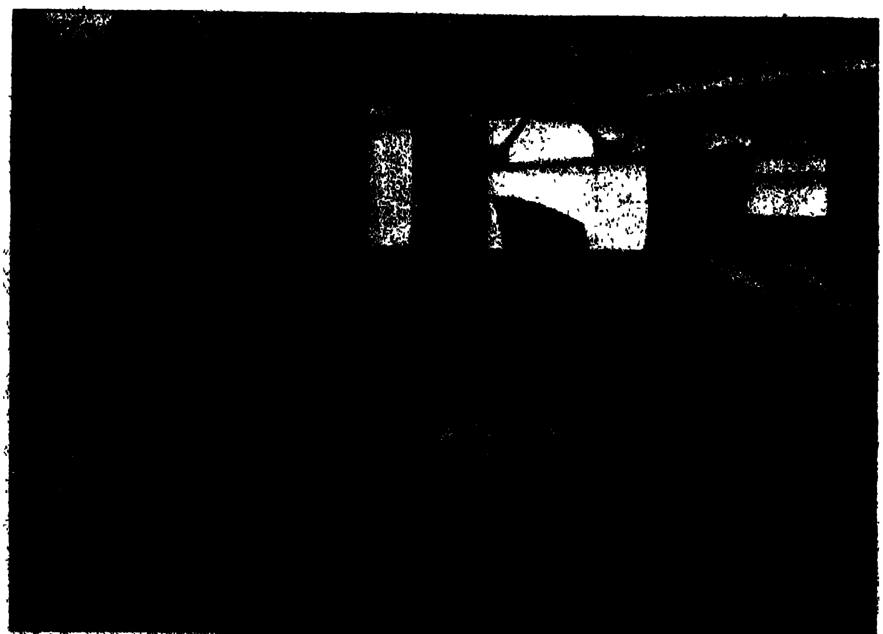
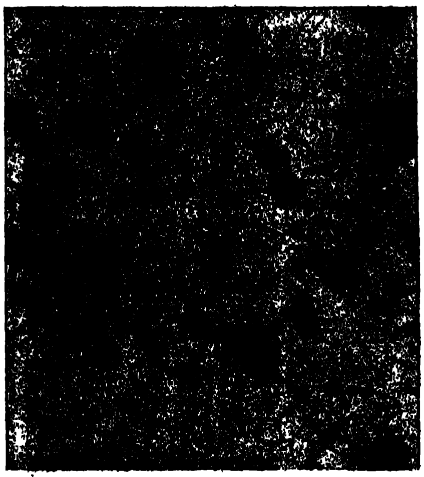
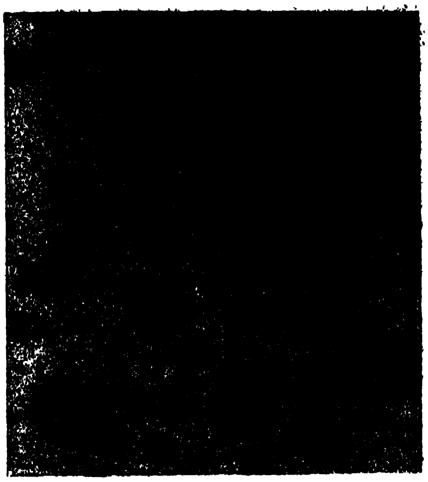


FIG. 5—A TRACTOR PULLS THE CARS FROM THE ANTECHAMBER

weigh 5 tons, making a total weight of 15 tons for each loaded car. Thus the 60 cars which compose the full charge total 900 tons which must be moved through the oven at each ad-





FIGS. 9 AND 10—MICROGRAPHS OF THE CENTER OF SAMPLES ANNEALED IN THE TUNNEL KILN—THESE INDICATE THE STRUCTURE OF NORMAL MALLEABLE - NOTE THE TEMPER CARBON SURROUNDED BY FERRITE

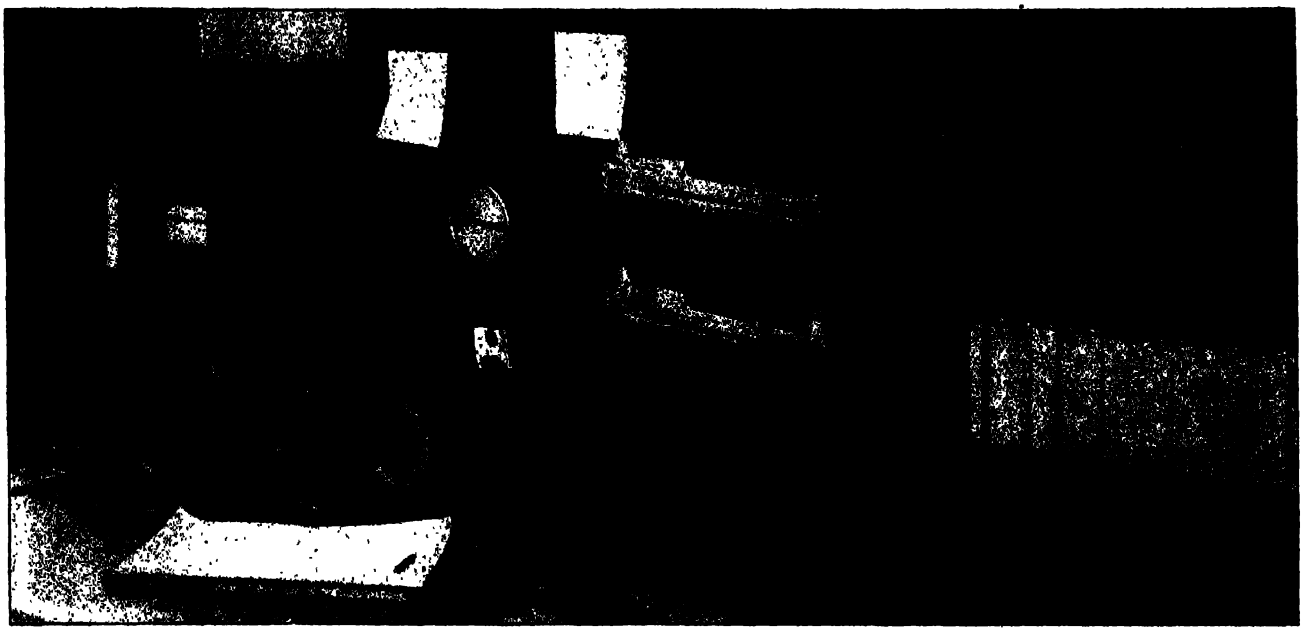
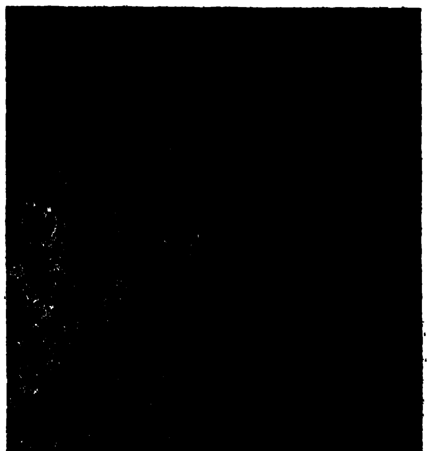


FIG. 11—TEMPERATURE READINGS ARE MADE THROUGH A MULTIPLE CONTACT SWITCH



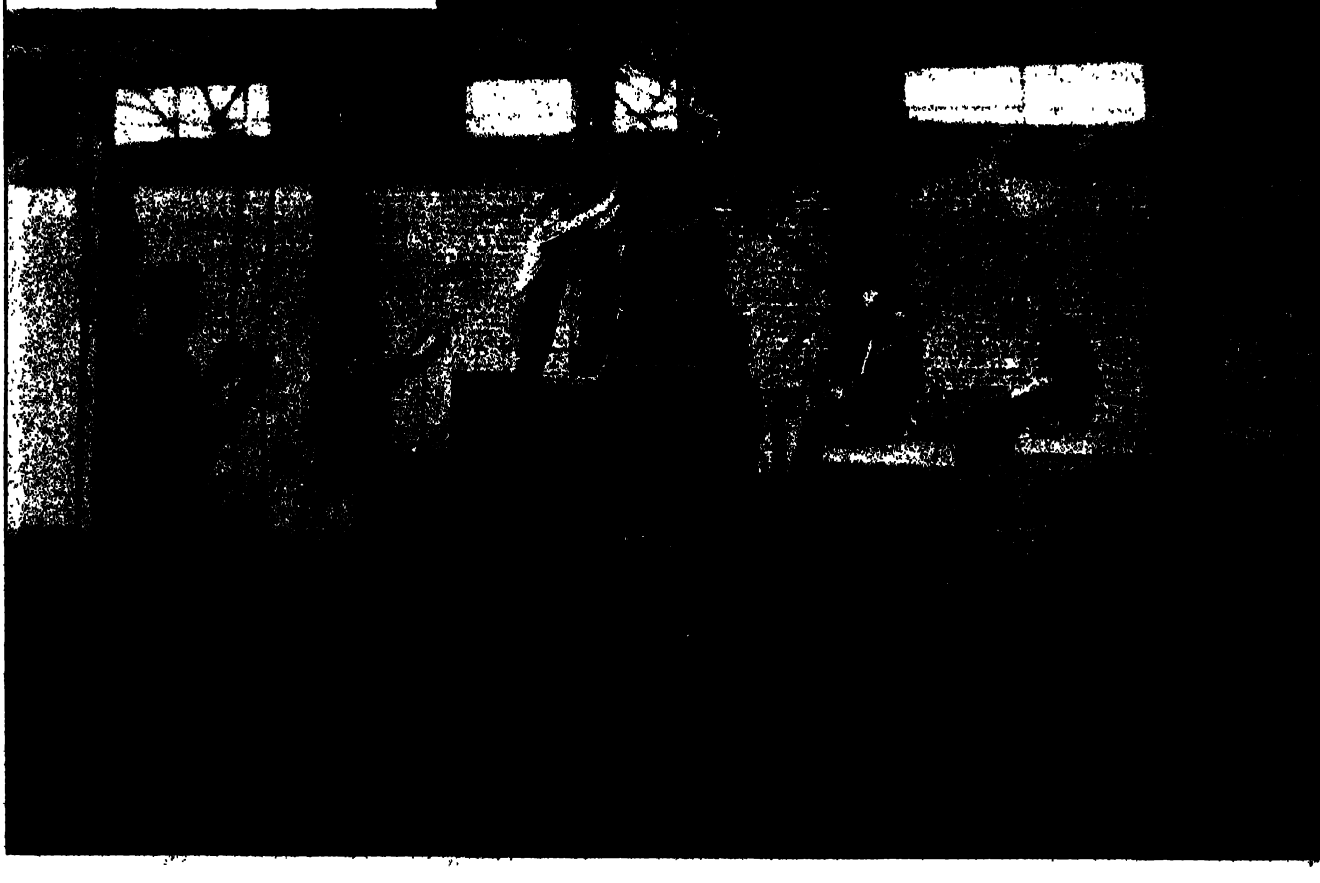
FIGS. 12 AND 13—MICROGRAPHS TAKEN FROM THE EDGE OF CASTINGS, SHOWING A SLIGHT OXIDATION AS INDICATED AT THE TOP OF THE ILLUSTRATIONS

mission of a new car into the oven.

Cars are run into the antechamber of the kiln on a transfer car and from this car they are pushed into the kiln by an hydraulic ram. This ram may be noted in Fig. 4 which shows a car partly pushed into the kiln. The door into the antechamber was left open to allow the photograph to be taken. In actual work, the door between the antechamber and the kiln is closed before the door into the foundry is opened. The car then is placed in the antechamber and the outer door is closed. The air in the antechamber is then washed out by blowing exhaust gases from the combustion chamber through the hole shown in the bottom and out through the stack in the roof. After the air is all out of the antechamber the door into the kiln is opened and the car is pushed in by the hydraulic ram. The door into the kiln is then closed and the antechamber is ready to receive another car. The door is operated by a large hand wheel. One of these wheels may be seen on top of the furnace in Fig. 5 which is a view of the exit end. This illustration shows a car being pulled from the antechamber by a tractor to which it is attached by a wire rope. The last car in the kiln is pulled into the antechamber by a windlass operated by two workmen. This windlass may be seen between the two men standing in the center of Fig. 5. The empty space left by this car allows a car to be shoved in at the other end of the kiln without opening the door between the kiln and the exit antechamber.

The tractor is weighted with pig iron to give it traction enough to pull the car. The front end of the tractor is fitted with a bumper so that it may push the annealing car off the transfer car and deliver it to the unloading floor to which it is pushed on a track. However, before it is un-

FIG. 7—WHEN THE POT REACHES THE END OF THE GRAVITY CONVEYOR IT IS LIFTED ON THE CAR BY A CRANE
FIG. 8—POTS ARE LIFTED OFF THE CARS AND THE CASTINGS DUMPED INTO THE BODY OF A TRUCK



loaded it is allowed to stand on the cooling floor for 12 hours. A portion of this time it is directly under a pipe through which cooling air is blown on the pots. Fig. 8 shows a stack of pots being unloaded. The crane picks up one pot at a time and carries it over the body of a tractor, when the castings are shaken out. The tractor then takes the castings to the cleaning and sorting room and the bases and plates are set on the gravity conveyor and carried to the loading section. Being annealed without packing, there is only a small amount of cleaning necessary on a few of the castings which were not thoroughly cleaned of sand in the hard cleaning room. Many castings are sent to the customer as they come from the annealing kiln.

The temperature through the kiln is controlled in a measure by the rate at which cars are put through. It has been found practical to charge the kiln at the rate of either 10 or 12 cars a day. Charging 12 cars a day a car goes through the furnace in 120 hours or 5 days, while when the rate is 10 cars a day 6 days are required to complete the cycle. The kiln is operated seven days a week while the foundry is only producing castings on six days. The loaders and unloaders operate only six days a week but an excess of cars are loaded each day so that there is a supply for the time the foundry is closed and the kiln is operated. Then, during Sunday, a number of loaded cars from the kiln are accumulated. To care for this contingency an excess of 23 cars are kept on hand. The output of the kiln may be regulated to a degree by changing the rate at which the cars are charged into the furnace. Indications are that this rate only may be varied from 10 cars a day to 12 cars a day but a much wider variation may be found to be practical.

The temperature through the furnace is shown by the chart in the lower right hand corner, Fig. 1. This curve shows the temperature of the portions of the furnace occupied by a car at different times as it traveled through the kiln. The chart indicates that the temperature of the gases in the furnace as they were passing out was approximately 800 degrees Fahr. From this temperature the furnace is gradually heated up until it reaches 1600 degrees Fahr. The cooling end of the furnace was about 800 degrees Fahr. In these two cycles, the pots which were charged into the furnace at the rate of 10 cars per day cooled to the same temperature as those charged at the rate of 12 cars per day, but they were held at the maximum temperature for a slightly longer time. The chart shows the discharge gases to be reduced to 800 degrees Fahr., the excess heat being absorbed by the cold pots entering the kiln. Should experiments indicate the advisability of cooling the pots quicker, this could be done by drawing cool air through the cooling chambers at the end of the kiln, as previously mentioned. Thorough tests were made of the metal in five different heats to determine the effect of the anneal. These tests were carried out by Prof. A. E. White, University of Michigan. Results of these tests which showed a minimum tensile strength of 49,300 pounds per square inch, and a minimum elongation of 10.5 per cent in 2 inches are given in the accompanying table. The analyses of all five samples show them to have the normal composition of the iron produced at the Saginaw foundry. Micrographs were made to show the structure of the metal. Figs. 9 and 10, illustrating the characteristic structure of malleable iron composed of temper carbon and ferrite, are representative of the centers of all five samples. Figs. 12 and 13 show the structure of the edge of different samples. One sample, Fig. 12 shows at the edge a ferrite rim inside of which is a ring of pearlite and ferrite, and next to this is normal malleable consisting of temper carbon and ferrite. Fig. 13 illustrates the structure at the edge of another sample. The skin, indicated next to the black portion of the cut consists of a mixture of ferrite and pearlite, while the portion behind this is made up of the normal structure of malleable iron. None of the rings in these two figures averages more than 0.005 inch in thickness. These micrographs indicate that the skin of the castings was slightly oxidized. To overcome this, it was decided to lute the joints between the pots and the covers, with mixture of clay and sand. This prevents the slight oxidation of the skin which otherwise would take place during the anneal.

Composition and Properties of the Annealed Iron

	Heat Analysis					Test Bar Analysis	
Sample No.	Carbon	Manganese	Phosphorus	Sulphur	Silicon	Carbon	Silicon
1	2.55	0.25			0.85	2.10	0.83
2	2.55	0.20			0.95	2.25	0.95
3	2.55	0.28	0.164	.051	0.85	2.05	0.80
4	2.00	0.31			0.95	2.20	0.95
5	2.50	0.25	0.160	.052	0.95	2.15	0.88

Physical Properties Sample No.	Ultimate Tensile Strength	Per cent Elongation in 2"
1	51,500 lbs. per sq. in.	14.80
2	49,300 lbs. per sq. in.	10.90
3	53,000 lbs. per sq. in.	14.80
4	50,400 lbs. per sq. in.	10.50
5	49,400 lbs. per sq. in.	10.50

The Saginaw company states that the first cost of this kiln is somewhat higher than the cost of the number of periodic furnaces which would be required to anneal the amount of castings annealed by the tunnel kiln. The length of time the kiln has been in operation is too short to determine the amount of saving in labor this method of annealing will effect over the periodic method. As at present operated three packers are required, three men load the stacks on cars, one man lutes the pots and four laborers unload the annealed castings and place the empty pots, bases, plates and base boards on the conveyor. These men work one shift six days a week, but the six heaters work in two shifts seven days a week three on a shift. The heaters put the cars in and out of the kiln and one of them takes hourly temperature readings of the pyrometer couples. Besides this gang, part time of two truckers is required to carry the castings to and from the kiln and to move the cars. A kiln foreman has direct charge of the operation of the kiln but does not supervise loading or unloading the cars, which duty is relegated to the labor foreman. When operating full with no delays, approximately 60 tons of castings are annealed each of the seven days in a week.

The advantages which the Saginaw company find in the tunnel kiln are a shorter annealing time which is cut from an 8-day cycle to a 5-day cycle, and a more uniform product. This latter is said to be marked. Then, too, owing to not using any packing material it is unnecessary to clean 80 per cent of the castings, but this percentage can be shipped to the customer as they come from the kiln. The ability to anneal without packing is attributed to the almost neutral atmosphere in which the pots are kept during the anneal. This is accomplished because the kiln is almost a complete muffle with air excluded.

FORMULAS FOR THE BRASS FOUNDRYMAN

DATA ON ALUMINUM BRONZE

ADDING MANGANESE TO ALUMINUM BRONZE

The effect of adding manganese to aluminum bronze is shown by test. The alloy tested had following composition:

	Per Cent
Copper	89.00
Aluminum	10.00
30% Manganese copper	1.00

The alloy was cast into sand molds containing imprints of the standard nonferrous test bars, which were cast to size having 2-inch risers on either end of the grips as is usual in the case of aluminum bronze. The physical properties, on an average of three test bars were as follows:

Tensile strength, pounds per square inch	63,800
Elastic limit, pounds per square inch	19,700
Elongation, per cent in 2 inches	49.3
Reduction of area, per cent	42.1

CALCIUM-ALUMINUM BRONZE

The effect of calcium on aluminum bronze is illustrated by test. The alloy tested had the following composition:

	Per Cent
Copper	89.00
Aluminum	10.00
10% Calcium-copper	1.00

The alloy was cast into sand molds and the bars were cast to size. The average physical properties of three bars were as follows:

Tensile strength, pounds per square inch	54,000
Elastic limit, pounds per square inch	19,700
Elongation, per cent in 2 inches	22.5
Reduction of area, per cent	30.4

IRON IN ALUMINUM BRONZE

An alloy was cast into test bars attached to a keel block in the manner usual with manganese bronze. The following alloy was tested:

	Per Cent
Copper	89.00
Aluminum	10.00
Iron	1.00

The bars were cut from the block and machined to standard size. The following results were obtained:

Tensile strength, pounds per square inch	69,600	73,100
Yield point, pounds per square inch	20,400	23,000
Elongation, per cent in 2 inches	19.5	22.5
Reduction of area, per cent	23.0	21.6

—THE FOUNDRY DATA SHEET No. 345, AUGUST 15, 1920

FORMULAS FOR THE BRASS FOUNDRYMAN

DATA ON ALUMINUM BRONZE

IRON IN ALUMINUM BRONZE

Tests of an alloy of aluminum, 10 per cent; iron, 1 per cent; and copper, 89 per cent, with cast to size test bars were made. Risers 2 inches diameter were placed on either end of the grips. The bars were made with long grips. Four bars were cast and tested as follows:

	Bar, 1.	Bar, 2	Bar, 3.	Bar, 4.
Elastic limit	18,600	18,300	26,500	22,600
Ultimate strength	76,600	77,100	74,200	75,600
Elongation	26.0	27.5	23.0	27.0
Reduction of area	24.8	29.8	27.5	29.9

The elastic limit and ultimate strength are given in pounds per square inch, the reduction of area in percentages, and the elongation as percentage of stretch in 2 inches.

PHOSPHORUS IN ALUMINUM BRONZE

Alloy used as control:

	Per Cent
Copper	89.00
Aluminum	10.00
Iron	1.00

Alloy with phosphorus:

	Per Cent
Copper	88.90
Aluminum	10.00
Iron	1.00
Phosphorus	0.10

Results of physical tests were as follows:

	Control bar	Treated bar
Yield point, pounds per square inch	26,100	27,700
Ultimate strength, per square inch	76,400	70,000
Elongation, 2 inches, per cent	21.0	12.5
Reduction of area, per cent.	17.6	17.5

SILICON ALUMINUM BRONZE

The effect of silicon is illustrated by the following tests. The alloy consisted of the following proportions:

	Per Cent
Copper	89.50
Aluminum	10.00
Silicon	0.50

Result of physical tests were as follows:

Yield point, pounds per square inch	28,800
Ultimate strength, pounds per square inch.	77,000
Elongation in 2 inches, per cent.	1.5
Reduction of area, per cent.	1.4

—THE FOUNDRY DATA SHEET No. 346, AUGUST 15, 1920

How Spur Gear Patterns Are Made—

Approved Methods for Laying Out the Material and Afterward Joining It Together to Facilitate Molding and Prevent Distortion of the Patterns While They Are in Use

BY JOSEPH HORNER

ALTHOUGH many more gears are cut now than formerly, enormous quantities are still molded from patterns for machinery in which the fine degree of accuracy required for machine tools, electric cranes, automobiles, and so on is not essential. For all ordinary purposes, the cost of cut gears is prohibitive, and besides they are not necessary.

A higher standard of excellence is demanded and obtained in wood patterns than formerly. Sometimes teeth are shaped with fly cutters, and molded on machines. They are drawn through stripping plates and the castings come out without taper on the teeth, Wheel-molding machines using a segmental tooth block, and a dividing arrangement for pitching, also produce very accurate castings. Wheels are produced by either method as good for service as indifferently cut gears. It is also well to remember that the hard skin on cast teeth is favorable to their durability,

Spur gear patterns include a large number of different types, ranging from small pinions without arms; to Fig. 1 illustrates a small, solid pinion pattern at a definite stage of its construction; Fig. 2 shows one method of building-up a larger pattern. The alternative to Fig. 2 is to use segments, strictly, sectors, extending to the center, the building-up of which is shown in Fig. 3, with the grain disposed radially, so that no unequal diametral shrinkage is liable to occur. In Fig. 2 it is arranged tangentially, in which case the pattern may conceivably shrink in its diameter, and would do so if the diameter were large, and the segments wide. The grain is tangential in Fig. 2, but the sweeps

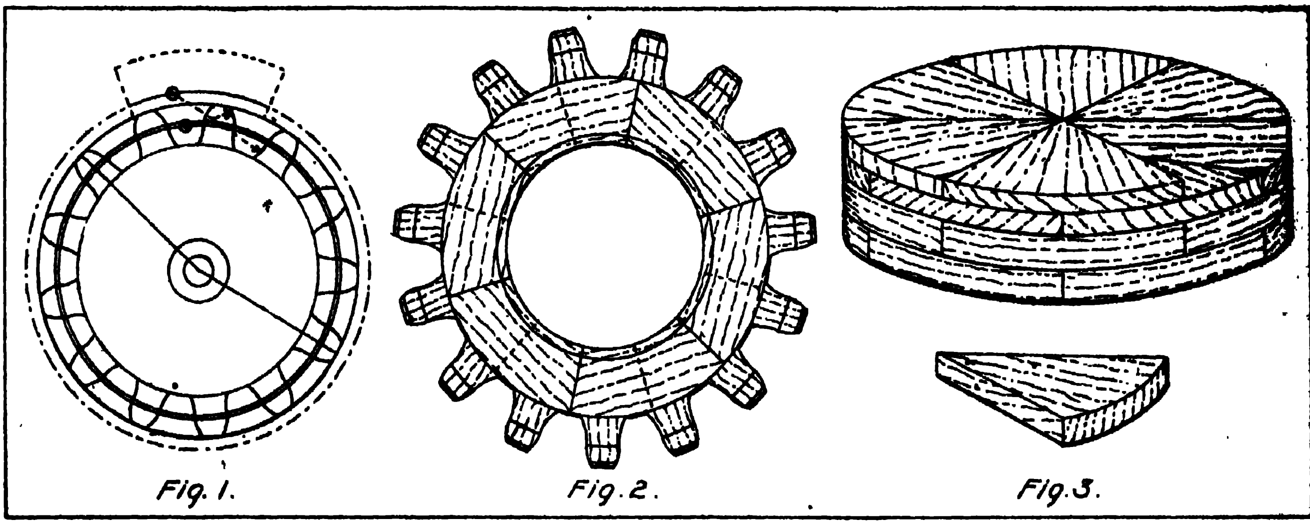


FIG. 1—SMALL PINIONS ARE CUT OUT OF THE SOLID FIG. 2—ONE METHOD OF BUILDING UP A LARGER SIZE FIG. 3—ALTERNATIVE METHOD TO THAT SHOWN IN FIG. 2

pitched mechanically; but apart from this practice which only covers a small proportion of the pattern gears made, the industry generally has been raised to a higher plane. Firms who have had little or no experience in the construction of gears should place them with those who make pattern gears a specialty. Those who construct their own patterns regularly understand how to secure permanence of form, and to proportion and shape teeth to meet present-day requirements. Development in the practice of cutting teeth has had an influence in improving pattern gear standards. If this were not so, more cut gears would be employed than at present. The practice of machine-molding also has had influence on gear pattern making Gears of fairly large dimensions are large wheels having arms; the number, and shapes of which vary both according to design and with the sizes of wheels.

Except for some very small pinions, measuring, say not more than 5 or 6 inches across, no pattern gears are cut in solid stuff. When below those diameters, they can be so cut, using a block of thoroughly seasoned pine, or mahogany, with the grain running longitudinally, that is, in the direction of the teeth. Anything larger must be built-up to prevent shrinkage or swelling of the grain from interfering with the shape and dimensions of the pattern. In no case should segmental pieces be prepared very thick or very long, since that would in a measure defeat the object desired. Several examples of good practice are shown in the accompanying illustrations. are both narrow and short, so that no perceptible diametral shrinkage can occur. Fig. 2 is preferable to Fig. 3 when pinion patterns exceed 7 or 8 inches in diameter, and this arrangement of sweeps is adopted in all gears up to the largest, but the number of sweeps is, of course, increased with diameters. The thickness of segments should not exceed about ½-inch in the smaller gears, and ¾ or ⅞-inch in the largest. With increase in number, the risk of distortion consequent on shrinkage is lessened. A large number of sweeps is mutually coercive, and binding. With small numbers of thick pieces, local shrinkage and distortion will occur in course of service.

Sweeped-work is built up in different ways. The sweeps are sawn from board with the band saw, using a templet sweep

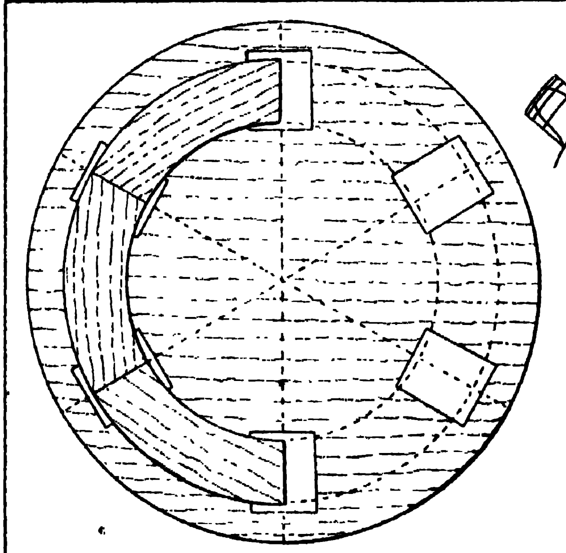


Fig 4

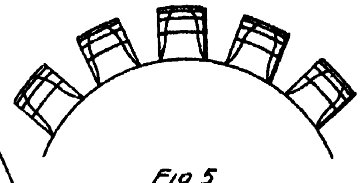


Fig 5

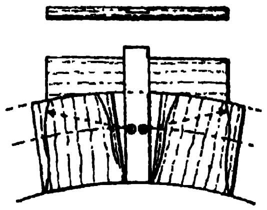


Fig. 6

FIG. 4—THE FIRST COURSE OF SEGMENTS IS GLUED ON PAPER STRIPS FIG. 5—METHOD OF FITTING AND LAYING OUT THE ROUGH TOOTH BLOCKS FIG. 6—TEMPLET ON WHICH TO LOCATE CURVE CENTERS

to mark them from. They are marked adjacent as closely as possible, to economize on lumber. Where a pony planer is available, it is good practice to bring the boards to the same thickness before sawing. They will be all of equal thickness, and the entire wheel can be built up before placing it in the lathe. Some slight correction with the trying plane will suffice on each course. The first course of sweeps is glued on paper strips shown in Fig. 4. When the glue has dried, the paper holds the entire job on the face plate. For added security, a screw may be put into each sweep from behind the plate, but only as a stand-by in the heavier patterns. It is not necessary to use anything but glue to secure the courses of segments to each other; but in order to avoid the delay while the glue is drying, it is usual either to drive wooden pegs, or wire nails in each course.

In all cases, with the single exception of very small pinions, typified in Fig. 1, the wheel body, or wheel rim is prepared independently of the teeth. These are attached to the rim after it has been turned. In Fig. 1, the teeth are cut in the solid wood. Wheel rims are turned either parallel, or preferably with a slight taper, and the teeth prepared separately, or the blocks from which they are to be cut when in place, are then attached. The amount of taper given is only that which would be indicated by a tight and an easy fit of the calipers on top and bottom; or by the contact of a set-square at the top, and just seeing the light through at the bottom. In small patterns, it can be measured with calipers; in large wheels a straightedge is laid across the front face, and a set-square is used against it.

Many different methods are adopted in fitting and cutting the teeth. The choice depends chiefly on the degree of accuracy and permanence of form desired in the pattern. Teeth are cut solidly with the body in small pionions. They are glued on the body and there worked from cubical blocks with chisels, gouges, and planes. They are worked with fly cutters, and pitched mechanically. They are worked away from the rim, and glued on afterwards. They are attached to the rim with dovetails, and afterward worked away from the rim with planes, and returned to their correct positions by the dovetail fittings.

Fig. 1 illustrates the cutting of teeth on the body block—the grain running axially. The block is turned to the outside diameter of the teeth, and the teeth pitched and marked out according to the standard system. This is done first on one face, and then one or two tooth centers are drawn across, carried over perpendicularly, and the teeth marked similarly on the other face. Concentric circles are struck on which the centers of the tooth curves are set. They may both fall within the diameter of the block, or one for the roots will come without in small pinions. A templet, shown dotted, is then used to set the compass point on. After having been marked, wedge-shaped pieces are sawn out between the teeth, leaving them to be worked with the hand tools or with a fly cutter.

Teeth are worked in place with chisels, gouges and planes, not only when small pinions are cut in solid stuff, but also in large gears. The blocks for the teeth are glued on the rim with allowance for turning the tops and the ends. When they have been turned, the pitch lines, and lines of centers are struck on one face, the centers pitched and squared over as in Fig. 1, and the teeth marked on both faces. Though this may seem an undesirable method, using gouge, chisel and plane, it is accurate in the hands of an experienced man. A thin straightedge, narrow enough to go between the teeth is used, its edge being rubbed with chalk or with red lead to check the work of the gouge and chisel, since a rebate plane can only be used for the upper portions of the tooth faces. The teeth are sandpapered carefully, using a rubber planed on one side to the concave curvature of the tooth flanks, of cycloidal design, and flat on the other side for the convex curves. The advantage of the method is, that the teeth are permanently fixed when glued, and being afterward nailed, they cannot readily be shifted.

The rough blocks are fitted either as in Fig. 5 or Fig. 7, the latter, showing filling-in pieces to afford support to the blocks while they are being turned. The pieces are not necessary if the turning of the tooth ends is done carefully, with light cuts, especially if the leaving sides of the teeth are chamfered with a chisel before commencing.

Teeth are worked separately and set on the rim by center lines. They can be shaped accurately and more readidly

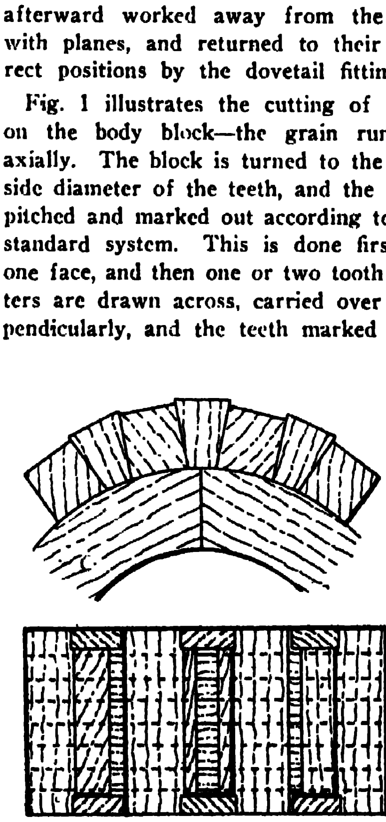


Fig. 7.

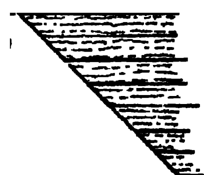


Fig. 8.

FIG. 7—REINFORCING BLOCKS ARE PLACED BETWEEN THE TEETH WHILE TURNING
FIG. 8—USING THE SQUARE TO VERIFY THE POSITION OF THE TEETH.

with planes, than they can be cut with gouge and chisel, after the blocks have been affixed permanently to the rim. The object to the method lies in the difficulty of setting them on the rim to correct pitch, and square across.

The teeth are worked in a templet block several inches longer than the

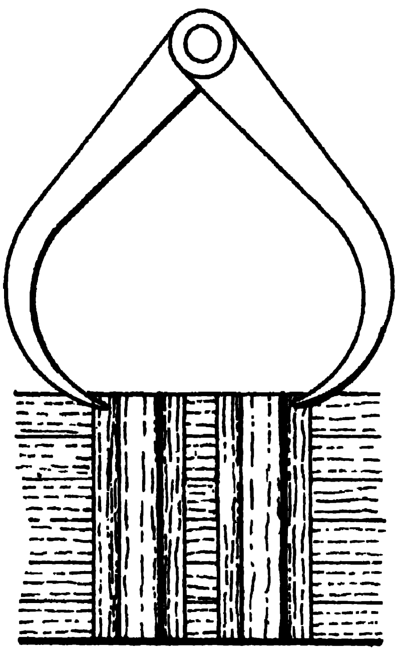


Fig. 9.

FIG. 9—THE CALIPERS ARE USED TO TEST THE PITCH

teeth, made of some hard wood, and notched to receive the blocks. These are prepared in strips, planed on one face to bed in the bottom of the recess cut in the block, and sawn off and squared to neat lengths with the chisel or the mitre cutter to fit in the templet block when driven in lightly with the hammer. They are then shaped with a round plane and a rebate plane by the guidance afforded by the contour of the block. A center line is scribed along the top of the tooth from a line on the block, and the tooth is knocked out with a pin thrust through a hole provided for the purpose in the back of the block. With the observance of ordinary care to avoid taking shavings off the templet block, the teeth should come out all alike. To set them correctly on the rim, a center line is squared down over the ends of each tooth from the longitudinal center already marked from the block. These lines are set against center lines pitched round the rim with spring dividers, or with a dividing apparatus when such is available. Alternatively, teeth may be set by their edges instead of by centers.

Although the teeth cannot be set with perfect accuracy by lines, yet approximate accuracy can be secured by subsequent checks. No attempt is made to nail them to the rim until the glue by which they are attached has dried, and before this sets, the caliper and square are brought into use, one to test the pitch, the other, the setting of the teeth square across the rim. The employment of the square is shown in Fig. 8. One edge is laid against a straightedge held across one face of the wheel rim, the other edge checks the side of the tooth. Fig. 9 shows the calipers testing the pitch. The pattern is left on the face plate on which it has been turned, while the teeth are being nailed and tested, and screwed on a wooden mandrel fastened down on the bench. This is better than attempting to hold the pattern body in a vise. It is held on the mandrel and can be turned round freely with no risk of squeezing the body, or of shifting the teeth.

Patterns that are delivered by hand must always have some draft, those which are drawn through stripping plates need not have any. A little taper on the rim is helpful, but taper in teeth is so objectionable that it is always kept as small as possible. It should not exceed the difference made by taking two or three of the finest shavings off one end more than off the other, the difference between a tight and easy fit when checked by the calipers.

Teeth are attached to their rims with dovetails when it is desired to secure the advantage of shaping the teeth with planes, without the risks of inaccurate

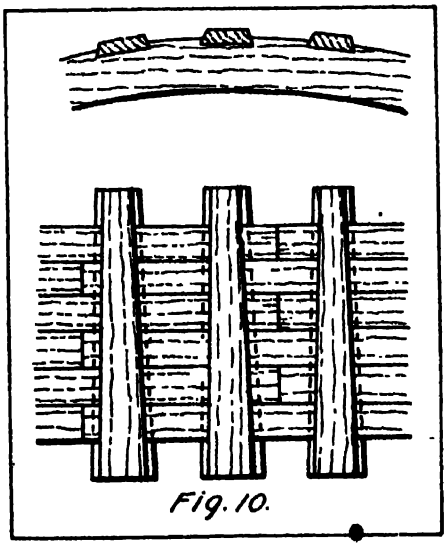


FIG. 10—THE DOVE TAIL BLOCKS ARE LEFT A LITTLE LONG TO ALLOW FOR VARIATION IN THE DRIVING FIT

setting by center lines on the teeth and the rim. The sequence of operations is as follows:

The rim having been turned, is pitched round, and the center lines squared across. A templet dovetail is made, having a center line by which it is set on these pitch lines, and the edges are marked therefrom. Shallow dovetails

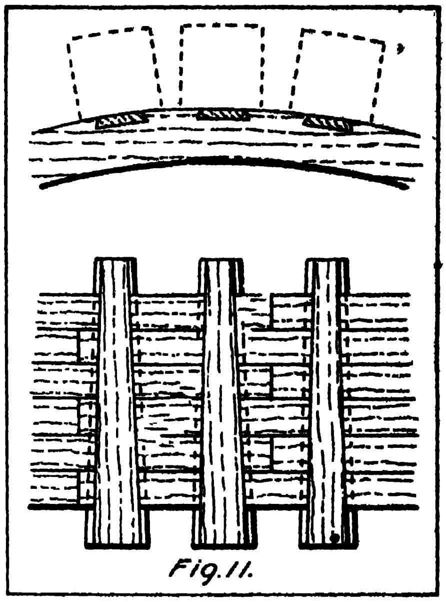


FIG. 11—THE TEETH BLOCKS ARE GLUED ON TO THE DOVETAILS

are cut by these lines with a fine saw, to a depth of about 3/16-inch, the depth having been set by lines struck round in the lathe on both faces of the rim. Then the depth is removed to these lines with a chisel and narrow rebate plane. The strips which are to form the dovetails are next fitted in by planing, their lengths are an inch or so more than the width of the rim, Fig. 10, in order to allow for variations in driving fits. When driven home with light hammer taps the ends are sawn off to about ⅛-inch longer than the width of the rim and the outer faces are turned flush with the periphery of the rim.

The blocks for the teeth are now sawn off from long strips of a cross section large enough to cut the teeth from, and about ⅛-inch longer than the width of the rim. They are hollowed with a plane to fit the rim, and glued on the dovetails, Fig. 11, using only a small quantity of glue, so that no excess shall work out beyond the width of the dovetails and get on the rim. After the glue has hardened, the dovetails are knocked out, carrying the teeth with them, and two or three small nails are driven through the backs of the dovetails into the teeth as a measure of security. They are then returned into their places. It is well now to mark them consecutively, 1, 2, 3, etc. The teeth are then turned. This can be done safely with light cuts, using a sharp gouge, and finishing with a keen scraping chisel. The precaution may be taken of chamfering the leaving edges of the tooth blocks with a chisel, to prevent risk of splitting out the edges, though with care, this is not necessary.

As the teeth have to be marked in place, the pitch lines and any lines of centers required for tooth radii are struck round on the turned ends of the teeth. To have these exactly alike on

both ends, as well as for convenience of turning the ends, it is usual to rechuck a pattern rather than face the rear ends of the teeth at the same chucking as the front. The pitching of the teeth is done round on one side first. It is convenient to divide round into multiples of the pitch first. Groups of four, six, eight, etc., may be thus divided, to be subdivided for the separate teeth. It is necessary to square a few pitches across, preferably at the multiple divisions, from which to start the pitching on the opposite side. A try square is hardly accurate enough for this because its stock has to lay round the curve of the wheel rim. A better method is to use a set square worked from a straight edge held across the face of the rim. Or to lay the face on a true drawing board, and set the square up from that, turning the square also round from right to left, to correct any possible error. Or to use the geometrical method of raising a perpendicular from a base line, setting the compass legs in center points on a circular line slightly within the edge of the rim.

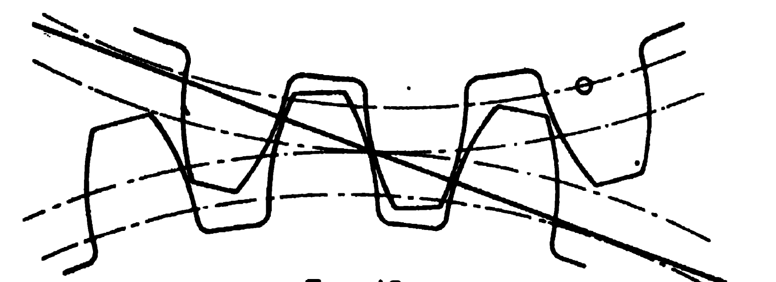
From the pitch points the tooth thicknesses are pitched to right and left on the pitch line. When the centers for the tooth curves happen to come between the teeth, a templet can be used on which to locate them as in Fig. 6. It is of wood, fitting the curve of the tooth points, and having a tongue of zinc inserted, on which the center is located for the divider point.

After the teeth have been marked they are removed by knocking out the dovetails and having first set in both ends of the teeth carefully to the lines, they are roughed with chisels and gouges, and finished with planes. These ends are rubbed with red lead, the disappearance of which indicates when the teeth have been planed to the lines. They are then sand papered with a rubber, and returned to their places, in which they are glued permanently. If care is exercised at each stage, this is the most accurate method of constructing pattern gears, apart from the employment of mechanical aids.

There is one other modification in the fitting of tooth blocks which is adopted when the teeth are shaped with fly-cutters, one which provides for cutting radii in the roots. The tooth blocks are made wide enough to include the radius or fillet. Instead of fitting the teeth singly, as described, they are generally fitted in blocks wide enough to include three or four teeth. To avoid the keen feather edge where the radius merges in the rim, the rim is often turned under size by from ¼ to ⅜-inch leaving a thickness at the roots of ⅛ or 3/16-inch. The best pattern gears are made in this way and there is no risk of feather edges curling up after frequent molding.

Until recent years practically all pattern gears were made with double curved, cycloidal teeth, as in Figs. 1, 2 and 5 and struck by means of one standard generating circle by which interchangeable meshing of all gears of the same pitch is ensured. During recent years, the involute single curve has been adopted extensively. The double-curved teeth are not likely to become obsolete, since in the opinion of many they possess advantages over the others for severe duty and smooth running. As the majority of existing cast gears have been after this style, it is obvious that the calls for renewals must be met. The growth of the involute form, favored by the practice of cutting, tends to displace the cycloidal teeth in a considerable proportion of new designs of machinery.

Unfortunately, there is no commonly-accepted standard for either type of tooth either in respect of curvatures, or of lengths. The older proportions both for cycloidal, and involute teeth are generally abandoned for shorter teeth. With regard to curves, in those for cycloidal teeth, base pinions with radial flanks may have either 15 or 1 teeth, the diameter of the standard generating circle being equal to the radius of the base pinion. In the involutes, the pressure angle, Fig. 12, may range between 14½ degrees and 22 degrees. Here the curves are generated from the base circle, the tangent to which is the line of pressure, Fig. 12, and not as in the cycloids, from the pitch circle. Fig. 13 shows the method of marking the curve.



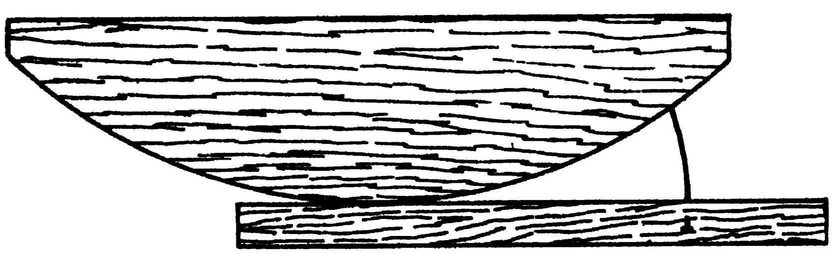


FIG. 12—IN INVOLUTE TEETH THE CURVES ARE GENERATED FROM THE BASE CIRCLE THE TANGENT TO WHICH IS THE BASE OF PRESSURE FIG. 13—IN CYCLOIDAL TEETH THE CURVES ARE GENERATED FROM THE PITCH CIRCLE

Organize Steel Casting Company

New York interests controlling the American Chain Co. have organized the Reading Steel Casting Co., with an authorized capital of $2,500,000 of preferred stock and 25,000 common shares of no par value, under the laws of New York state, and the latter company has purchased the business and assets of the Reading Steel Casting Co., Reading, Pa. The officers of the new company are: Chairman, W. D. Lasher; president, J. Turner Moore; treasurer, E. L. King; secretary, M. G. Moore. The five officers, together with W. F. Wheeler, comprise the board of directors. The executive headquarters of the new company will be located in the Grand Central Terminal building, New York, where the American Chain Co. has its headquarters.

Consolidated Interests to Build Foundry

To insure a supply of castings for their own use, as well as to take business for other consumers three corporations at Rockford, Ill., have formed the Forest City Foundry Co., with capital stock of $50,000 and will erect a foundry. The concerns interested in the new foundry are the Mechanics Machine Co., the National Lock Co. and the Rockford Lathe & Drill Co. Stock is also held by a number of individuals.

Pointers on Casting Monel Metal

Physical Characteristics of This Alloy Relate It to Steel in the Foundry Operations — High Melting Point Together with Large Shrinkage Make the Metal Difficult to Cast

BY REGINALD TRAUTSCHOLD

MONEL metal was successfully cast in 1908, when the propellers of the U. S. S. DAKOTA were poured. This was practically the first commercial use of the natural alloy smelted from the distinctive ore deposits of the Sudbury district, Ontario, Canada. Since then monel metal castings have been produced in a few foundries but today there is quite a lack of authentic information among foundries concerning the requirements for casting it successfully. The physical and thermal characteristics of the metal and their effects upon casting procedure are not generally appreciated. Too often there is a popular misconception that the metal resembles in characteristics the ordinary commercial alloys such as the brasses, bronzes, bearing metals or perhaps an alloy of the nickel silver class. However, monel metal is a decidedly individual and distinctive metal with quite special characteristics. It resembles the synthetic alloys in that it is noncorroding but in its other properties and founding characteristics it resembles steel.

High Temperature Necessary

The average composition of the metal is, nickel, 67 per cent; copper, 28 per cent, and other elements, chiefly iron, manganese, silicon and carbon, 5 per cent. The high percentage of nickel contained gives it a high melting point. In fact, only two other metals—nickel and steel—commercially cast must be subjected to so high a heat for casting. This is shown in the following table:

Metal	Temperature Degrees Fahr.	Temperature Degrees Cent.
Brass, Naval	1570	855
Brass, Red	1780	970
Low grade	1795	980
Brass, ½ red, ½ yellow	1690	920
Yellow—Cast	1645	895
Bronze, Leaded	1735	945
Bronze with zinc	1796	980
Copper (pure)	1983	1084
Iron, Cast—		
(White)	2075	1135
(Gray)	2264	1240
Gun metal	1823	995
Leaded	1796	980
Manganese bronze	1600	870
Monel metal	2480	1360
Nickel	2642	1450
Steel	2552	1400

All of the customary and characteristic difficulties encountered in securing satisfactory castings of high melting point metals are encountered with monel metal. It is failure to follow high temperature metal founding practice which has been the chief cause of most of the difficulties experienced in securing good castings by those not sufficiently familiar with the peculiarities of the metal. Much less trouble would be encountered if the fact was appreciated that the foundry requirements for casting monel metal more nearly resemble those for steel, and are quite radically different from those affecting the casting of brass.

Results of Tests

The strength of monel metal may be judged from the following results which are the average of 172 heats tested for the Isthmian canal commission.

Yield point	37,093 lbs. per sq. in
Tensile strength	72,281 lbs. per sq in.
Elongation in 2 in.	34 per cent
Reduction of area	32 per cent

The other physical properties of monel metal are as follows:

Melting point	1360° C. (2480° F.)
Specific gravity (cast)	8.87
Weight per cu. in. (cast)	0.319 lbs.
Weight per cu in. (rolled)	0.323 lbs.
Coefficient of expansion, (20° C.–100° C.)	0.00001375 per 1° C.
Electrical resistivity, 256 ohms per mil-foot. (Temp. coefficient)	0.0011 per 1° F.
Electrical conductivity	4% (copper 100%)
Heat conductivity	1/15 that of copper
Shrinkage	¼ in. per foot
Hardness cast material	20-23 (Shore scleroscope)
Modulus of elasticity	22,000,000-23,000,000

A temperature in the neighborhood of 1550 degrees Cent., 2820 degrees Fahr., is essential for pouring monel metal. The metal must be subjected to such a heat in the furnace for some time, because its heat conductivity is low; about 1/15 that of copper.

Obviously, these heat requirements are too severe to permit the use of the customary brass melting furnace. A type of furnace adaptable to melting high temperature metals is necessary, such as an oil-burning furnace of the reverberatory type or an electric furnace. Crucible furnaces have been used successfully, but this type is not to be recommended. The electric furnace has proved the most advantageous, as a rule. The metal can be brought to heat rapidly in it and maintained at the required temperature. Thoroughly heated in such a furnace, the metal flows well even for small intricate castings.

A reverberatory furnace of a somewhat special construction can also be satisfactorily employed. It should be fired with oil and operated under natural draft. The floor of the reverberatory furnace first should be covered with a layer of charcoal without flux, before the metal in the form of ingots is charged. A blanket of slag, to prevent excessive oxidation of the metal, should cover the molten metal until shortly before tapping, when it should be partially skimmed.

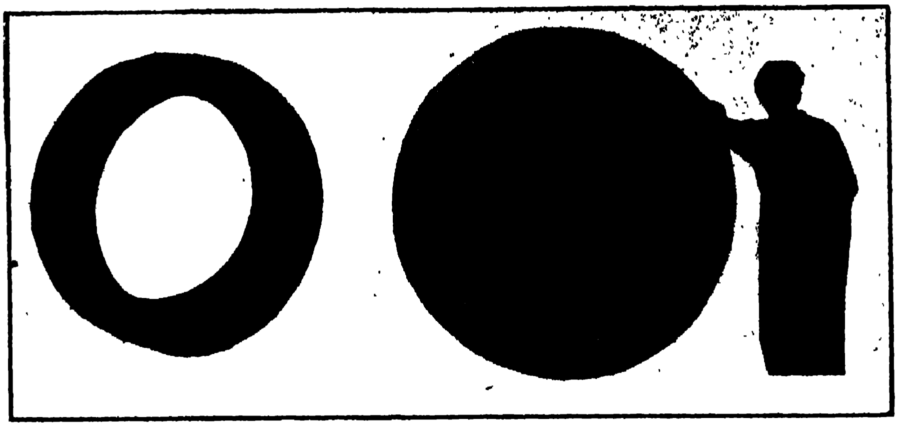
Though only the electric and oil types of furnaces are here recommended for melting monel metal, it is not meant that a crucible furnace cannot be successfully employed. One of the foundries which has been casting monel metal successfully for a number of years uses crucible furnaces operated on fuel oil. This particular foundry favors the crucible furnace, but its successful use has only been attained by discovering means of overcoming difficulties which are not present when employing either of the other two types of furnaces for melting monel metal.

Tapping monel metal should never be attempted until the charge has been thoroughly melted and brought up to a temperature of about 1550 degrees Cent. Before drawing off the molten metal, the blanket of protecting slag should be partially removed. During the pour magnesium should be employed as a deoxidizing agent, but otherwise no special agents should be used. Pouring should be accomplished as expeditiously as possible.

Refractory Molding Sand

Clay-lined ladles of the ordinary type are suitable for holding the molten metal. An iron stirring rod may be safely used, if care is exercised to prevent longer contact between the iron rod and molten monel metal than is necessary. Monel metal has a strong affinity for iron, therefore extended opportunity should not be presented for the hot metal to take up iron from the stirring rod. Though a small addition to the natural iron content of monel metal may be no special objection, care must be taken to see that this does not become excessive.

An important contributory factor in the production of sound monel-



MONEL METAL'S RESISTANCE TO CORROSION MAKES IT ADAPTABLE FOR TURBINE CASTINGS

metal castings is the quality and character of molding sand employed. The facing sand should be mixed with a generous proportion of sea coal. For fine work, an Albany, or brass molding sand is recommended. For larger castings the fine, strong and extra strong Lumberton sands, mixed with silica sand and sea coal, generally prove the most satisfactory.

Skin drying of molds for monel-metal castings is a safeguard almost always advisable. This is particularly true in the case of all heavy castings. As a rule, facing mixtures should contain little or no flour. Each foundry customarily has its own favorite formulas for facing mixtures. A mixture which has proved satisfactory in steel founding and which promises to be equally effective in monel metal work, despite the use of a small percentage of flour, is as follows: Old molding sand, 52 per cent; new molding sand, 26 per cent; sharp silica sand, 10 per cent; sea coal, 10 per cent, and flour, 2 per cent. After the pattern is drawn, the mold should be brushed with dry plumbago and carefully hand polished. The coated surfaces of the mold should then be painted with a solution of molasses water and the mold dried for some time after a hard skin has been formed. The unusually thorough skin drying is made necessary by the requirement that volatile matter within the thermal range of the molten metal be driven from the sand so far as possible. The principal molding difficulties are those pertaining to suitable venting and gating. Risers should be plentifully employed and large vents provided. Unless suitable vents are furnished the metal will not lie close to the sand, and porous castings will result. Generous fillets, also, should be provided.

Cores

The question of suitable cores for monel metal castings is also a matter of considerable moment. That the cores must be unusually strong and refractory to withstand successfully the thermal strains developed by the hot metal is quite obvious, yet they must break free, and clear readily. Beach sand, rather than bank sand, containing not more than a small percentage of binder, mixed with a high grade core oil is quite generally employed for making the cores for monel metal castings. Core mixtures which have proved satisfactory for steel castings, have also been used with excellent results. However, beach sand and core oil is quite generally to be recommended for small cores. A suitable and typical mixture is made by intimately mixing beach sand with from 1½ to 2½ per cent by weight of boiled linseed, or high grade core oil. Cores made from such a mixture may be found at times not to be sufficiently hard for large cores, despite thorough baking. It is then necessary to add a certain proportion of ground fireclay to increase the core hardness. A special core mixture said to be satisfactory for large monel-metal cores is composed of silica sand, 80 per cent; ground fireclay, 10 to 15 per cent; flour 4 to 8 per cent, and boiled linseed, or high grade core oil, 1 to 2 per cent. When strains are liable to occur flour should not be used in the core sand mixture owing to the ease with which a core free from flour releases. Other suitable core mixtures for larger monel metal castings are:

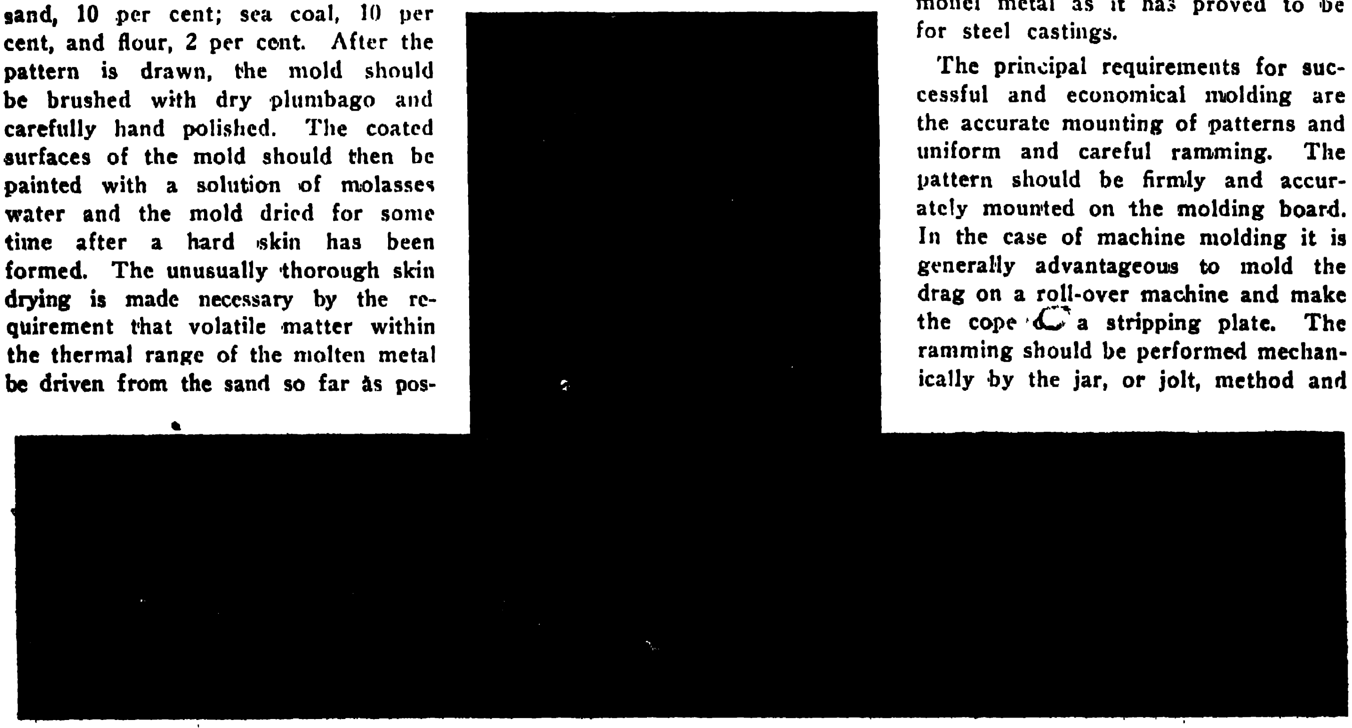
Silica sand mixed with 10 per cent ground fireclay and tempered with a 5 per cent solution of molasses water.

Silica sand mixed with a small proportion of boiled linseed, or high grade core oil and the core treated with a silica wash.

Equal parts of silica sand and silica flour tempered with molasses water.

Molds for monel-metal castings have heretofore been chiefly bench made, but excellent results have also been secured with the use of molding machines. In fact, machine molding would appear to be as practical for monel metal as it has proved to be for steel castings.

The principal requirements for successful and economical molding are the accurate mounting of patterns and uniform and careful ramming. The pattern should be firmly and accurately mounted on the molding board. In the case of machine molding it is generally advantageous to mold the drag on a roll-over machine and make the cope on a stripping plate. The ramming should be performed mechanically by the jar, or jolt, method and



A VARIETY OF CASTINGS ARE MADE FROM MONEL METAL—STRENGTH AS WELL AS RESISTANCE TO CORROSION IS SECURED

all possible mechanical aids should be employed for handling the flask, as it is imperative that it be disturbed as little as possible.

If the crucible furnace is disregarded, the reverberatory air furnace is quite generally employed for heats in which only a few hundred pounds of monel metal are melted, but the wisdom of such practice is open to question. For larger heats, a tilting electric furnace proves the more economical, as well as considerably more convenient. As such a furnace can be used for small heats, if its initial and operating costs are not too high, it usually proves the more economical in the long run for all monel-metal founding.

An advantage of the electric furnace is that the melting of the metal can be accomplished rapidly, on account of the intense temperatures that are developed. The ease with which the required temperature can be maintained in the electric furnace is particularly advantageous, for unless the consistency of the molten metal is correct for free flowing, and is so maintained throughout the heat, unsatisfactory castings and excessive scrap are almost certain to result. Maintaining the proper molten metal consistency to guard against the chilling of the metal is, in fact, one of the chief factors in the successful casting of monel metal.

Recapitulation

The essentials of successful founding of monel metal may then be concisely stated as:

Obtaining suitable metal temperature—about 1550 degrees Cent. (3000 degrees Fahr.).

Proper venting and gating of molds, with a plentiful use of risers.

The avoidance of any facing mixture or core content liable to produce excessive gaseous formations.

The avoidance of any substance in cores or facings which may fuse into the casting.

Thorough baking of cores and skin-drying of molds.

Castings varying in weight from a few ounces to 25,000 pounds each have been successfully poured from a wide variety of patterns from the simple to the complex. Ship propellers, pump linings and fittings, water wheels, turbine castings and a variety of castings ranging to the heads for golf clubs are made from monel metal.

These examples of monel-metal castings are presented merely as indications of the wide and growing demand for castings of this distinctive metal. Monel metal has established itself as important for many industrial purposes and every up-to-date foundry should be familiar with its characteristics and the approved processes to be followed in casting it.

The warning to be wary of the scrap added to the charge when charging the furnace, will prove valuable to the foundry contemplating working with monel metal for the first time, if it is heeded. A considerable amount of the scrap metal offered on the market is not pure monel metal, but some inferior synthetic alloy, or monel metal which has been doctored to such an extent as to lose much of its valuable characteristics. Good shear scrap can be used with some assurance of satisfactory results, but floor scrap is much more dangerous. It is apt to be mixed with iron in unduly large proportions and with other metals which are not conducive to a high grade casting mixture.

Monel metal is not a safe metal for the jobbing foundry to experiment with. Molding practice and the procedure for handling monel metal must be standardized, the metal must be poured at suitable temperatures and a high degree of molding skill is essential.

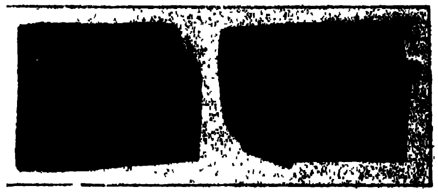
Monel metal is too expensive to experiment with, failures are too costly and unsatisfactory results are only to be avoided by a proper appreciation of the special skill required for the successful founding of the metal. However, the metal is being very successfully cast and through proper standardization of founding procedure and attention to pouring temperatures the defective casting loss, which otherwise is certain to be high is being kept down within reasonable limits.

Factors for Ascertaining Approximate Weights of Monel Metal Castings From Weight of Wood

Pattern	Factor	Pattern	Factor
Baywood	10.4	Maple	11.7
Beech	10.8	Oak, red	11.5
Birch	12.0	Oak, white	11.7
Butternut	13.2	Pear	13.3
Cedar	15.9	Pine, white	15.9
Cherry	12.2	Pine, yellow	13.3
Linden	14.7	Whitewood	15.7
Mahogany	8.3	Walnut, black	13.2

Cast-Iron Blocks Conserve Cupola Lining

With a heavy tonnage of metal to melt it is found economical to charge the cupola mechanically instead of by hand. Where pieces of scrap and pig iron are thrown in the cupola by hand, one piece at a time, the charge is built up regularly and little damage is done to the wall around the charging doors. However, by the mechanical method cars of metal usually are brought to the doors of the cupola and then tilted by a crane or a hydraulic ram so that the metal slides from the car into the furnace. This is quicker and saves considerable labor expense, but it has two disadvantages. When the metal slides into the cupola it strikes against the opposite wall and tends to pile up on that side unequally.

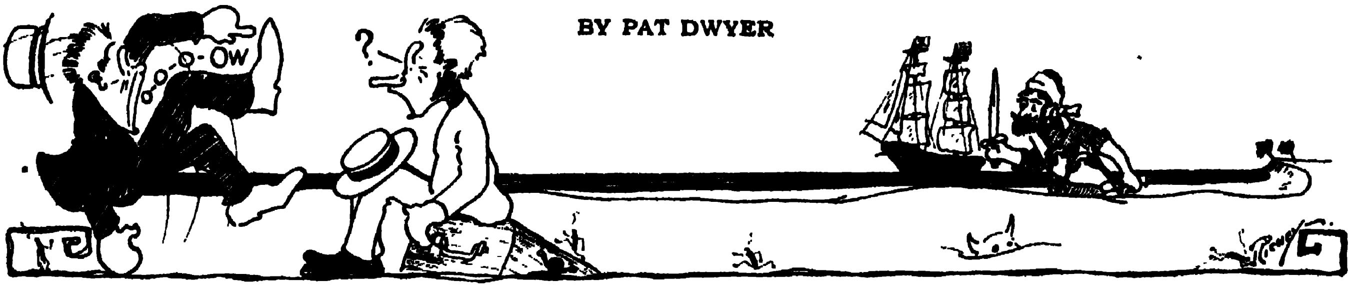


THE BLOCKS ARE CAST HOLLOW

This portion of the cupola does not get heated like the section further down near the melting zone and therefore, it is possible to line it with material which will better withstand the abrasive action of the falling charge. Some foundries take advantage of this to use different expedients to increase the life of the lining about the doors. The accompanying illustration shows cast-iron blocks of a type sometimes used to line cupolas about the doors. The block at the right sets as it is placed in the cupola while the one to the left is reversed to show the rear view. From this it may be seen that the blocks are made hollow to decrease the weight and to save expense. The recesses in the supporting webs, as may be seen in the figure to the left fit into the rib shown on top of the other Block. A circle of these castings is formed around the cupola from a point 1 foot below the charging doors to the same distance above the doors. A cast-iron false sill is placed in each of the charging doors before starting operations. This sill is 1 foot high, so the effect is the same as though the cast iron lining was extended 2 feet below the doors. Such a lining lasts about four months.

Bill Enters the Ring with the Foundry Jinx

BY PAT DWYER



BACK in the old days when we were boys together, Bill's chief ambition was to become a pirate captain and sail up and down the Spanish Main in a long, low, black, rakish craft flying the *Jolly Roger* from her mast head. Drake's, Flint's and Morgan's men were regarded with the deepest admiration and envy and his constant regret was that he had been born too late to accompany John Silver and the other gentlemen of fortune in Flint's ship the famous old WALRUS when she carried that august company safely home with her rail awash from the weight of treasure aboard and her decks ankle deep in the hot red blood.

Instead of going to sea, serving his time and eventually taking out a card as a journeyman pirate, Bill went into the foundry, where in addition to learning the business, he acquired a working knowledge of some phases of the English language which would have reflected credit on the roughest buccaneer who ever perjured his soul for a bottle of rum.

He no longer wishes to take part in scenes of carnage or do deeds of violence but he will stop at any time to enjoy a dog fight and there is not a prize fight or a boxing tournament pulled off within a 100 miles of the city in which he lives but he is bound to be at the ringside. Recently he invited me to accompany him to one of these events and see some real sport.

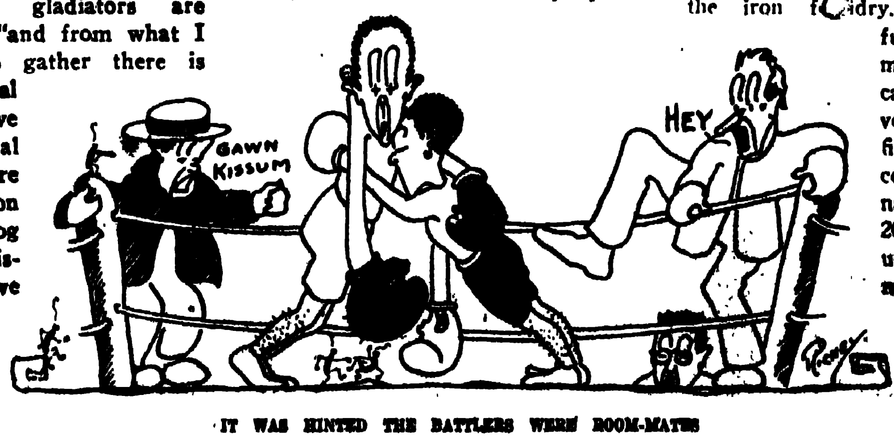
"Five pairs of gladiators are matched," said he, "and from what I have been able to gather there is going to be some real rough work. I have been told that several of the bruisers are doing their training on a diet of raw dog meat. Sounds promising, eh?" Well, we went and during the performance, the spectators exercised their inalienable right guaranteed them under the provisions of the constitution by expressing their opinion of the contestants in the most free and open manner. I was under the impression that the show was simply a boxing exhibition, but evidently most of those present, including Bill, thought otherwise. While the gentlemen in the ring were engaged in beating each other up he contented himself with smiling happily and clapping his hands, but when they clinched or danced around each other or indulged in any of the well known tactics practiced by experienced ring performers for passing the time, he implored the referee in the most earnest manner to "make those birds fight."

I think the only bout that afforded him real pleasure was the last, between two heavyweights. They *could* hit each other and they *did* hit each other some grievous wallops. It was scheduled for a 10-round go, but in the ninth round one of the heroes got on the inside track. He pounded his adversary to a pulp and knocked him out, to the great joy and delight of every person present with possibly one pulpy exception.

On the way home, I said to Bill that I wouldn't take all the money in a fair sized bank and take the beating one of the men received that afternoon. Bill said that if they gave him a shillalah and suspended all the rules so that he could fight any way he pleased and turned him loose among a flock of certain people he could name he would be willing to take a beating for the pleasure the occasion would afford him.

"Seriously, though," said he, "while we may differ in opinion and regard the boxing game with admiration or otherwise, there is no gainsaying that a man must have physical courage in a rare degree to take punishment and not lose his temper. However, there are other forms of suffering endured sometimes which try one's courage just as effectively as being pounded out of shape by a superior antagonist. If you ever lost a casting several times in succession and were at a loss to account for it, you will know what I mean. I'll tell you of an experience I had one time in which I was knocked out and had to take the count.

"I am not much of a believer in jinxes, hoodoos, and other forms of bad luck which infest foundries to a greater degree than any other form of industrial establishments; but I am free to confess that I came nearer to believing in their existence then than at any other time in a fairly extensive foundry career. The cause of all the trouble was a brass pump plunger 8 inches in diameter and about 5 feet long, having a metal thickness of 1¾ inches. A number of pumps in the plant were equipped with the same type plunger and consequently the job came into the foundry several times a year. The brass shop in this plant was located in part of one of the side bays in the iron foundry. It had four pit furnaces for melting miscellaneous brass castings, and one reverberatory furnace fired with bituminous coal. The latter furnace had a capacity of 2000 pounds and was used for melting the metal for the blast-furnace tuyeres, which as you know are composed of practically pure copper.



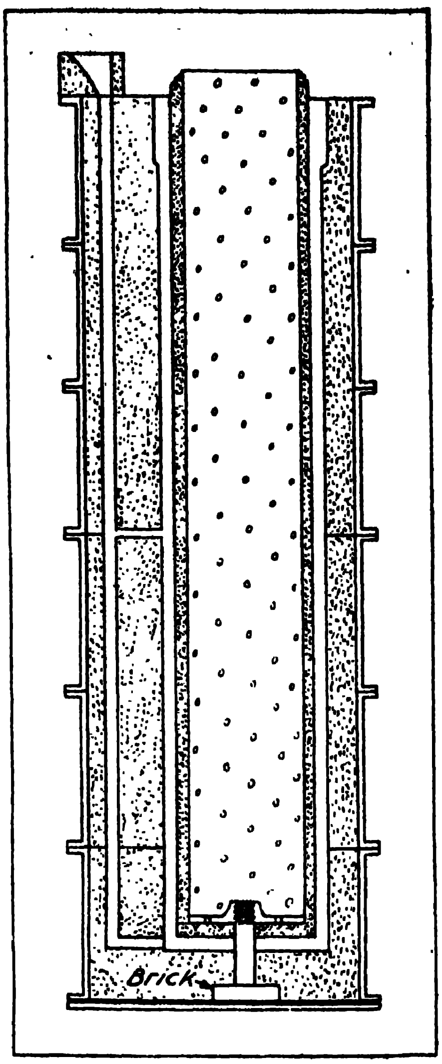
IT WAS HINTED THE BATTLERS WERE ROOM-MATES

About 1 pound of phosphor-tin was added to each 100 pounds of copper in the ladle.

"The plunger casting at first was made from a split pattern, horizontally in green sand. The two halves of the core were made of dry sand in a half core box and pasted. Sometimes the casting was good and at other times while apparently all right when leaving the foundry it was condemned in the machine shop after the first cut had been taken off. Skin drying then was tried but with indifferent success and finally the mold was dried in the oven and poured on end. This treatment gave satisfactory results on several occasions and then it was decided the next time the job came in to nail the two halves of the pattern together and mold it on end in a round iron flask, the core to be swept up in loam.

"No special precautions were considered necessary on the first casting. The mold was parted at the bottom and also at a point about half way up. An upright runner was employed, terminating in a gate at the bottom. An additional gate was cut at the half way joint to facilitate the flow of the metal and keep it fluid on its long course into the mold. The metal was melted in two crucibles and afterward dumped into one of the iron foundry ladles which then was picked up by the crane to pour the mold. The top of the mold was left open and the square portion which formed the top of the casting was carried up for about 6 inches to serve as a sink head or feeder. The casting poured nicely and the metal came up into the riser with only a slight flutter. It was shaken out next day and the core removed. The casting was perfectly smooth, the only chipping necessary being required to remove the gates; but you should have seen it after the machinist had taken a cut off. It was like a honeycomb from top to bottom.

"The blame first was laid on the mold which, it was thought had not been sufficiently dried. Another mold was made and dried thoroughly, but



ASSEMBLED MOLD FOR PUMP PLUNGER—THE STRAP ACROSS THE TOP FOR HOLDING THE CORE DOWN IS NOT SHOWN

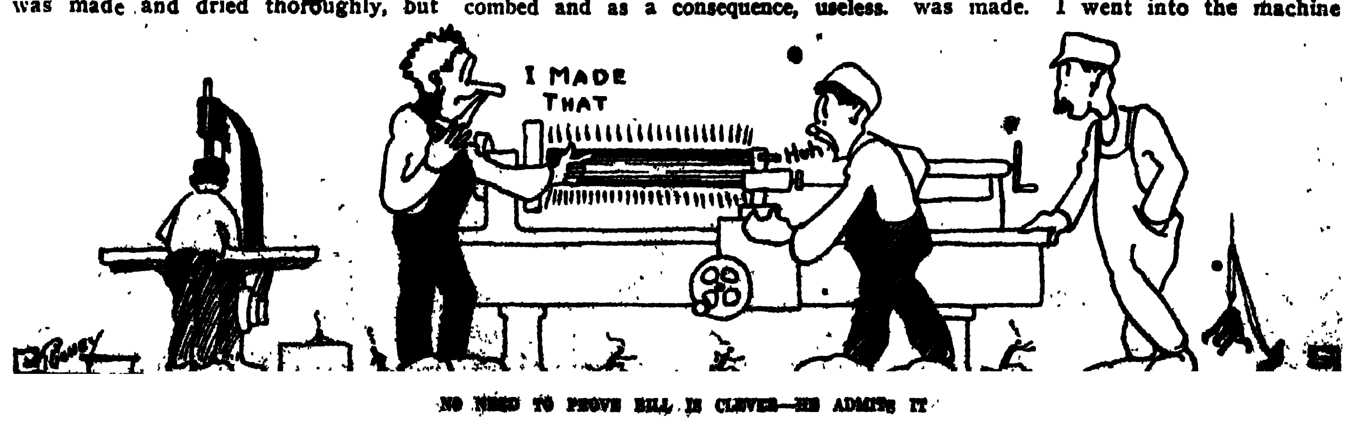
the result was the same. In the next one each course of sand was vented with a large vent wire and fine coke laid in a ring at each joint of the flask sections. That did not cure the trouble. Then it was decided that the trouble lay in the metal and special precautions were observed in melting it. On one occasion broken glass was employed to cover the molten metal in the pot and later, charcoal was used for the same purpose but in each instance the casting was honeycombed and as a consequence, useless.

When the sixth casting turned to be a waster I went over to master mechanic's office to tender my resignation. We were on quite friendly terms and under our joint incumbency the foundry previously had established several records of a different character from the one about which I am telling. He was a highly educated young man from the north of Ireland and he told me in a profane and friendly manner to keep on until I got a good casting. 'It will be time enough for you to quit when I tell you to,' said he.

"I went back to the foundry and decided to give the proposition one more shot and if the next casting was bad I was fully determined to fly away, resignation or no resignation. Each time the mold had been poured the vent from the core apparently had come off freely and my mind had been so prejudiced at first with the defective mold and later with the defective metal theory that the possibility of the core being at fault had not occurred to me. I now examined the core and thought I saw the nigger in the woodpile.

"I neglected to state at the beginning that the casting was closed at the bottom with the exception of one 1¼-inch hole in the center. The coremaker, of course, had selected the easiest way of making the core and had swept it up with loam and several thicknesses of hay rope on a piece of 1¼-inch pipe. The pipe was perforated, it is true, but the gas had to work through such a thickness of loam that it did not escape freely but caused a constant boiling of the metal while the mold was filling.

"I had a new core barrel made of 3½-inch pipe, closely perforated with ½-inch holes. One end was threaded on the inside to receive a perforated cast-iron disc. A short piece of 1¼-inch pipe was screwed into the disc to serve for a core print. One thickness of hay rope and one coating of open loam were sufficient to bring the core to the proper diameter. This core was used in the next mold that was made. I went into the machine



NO NEED TO PROVE BILL IS CLEVER—HE ADMITS IT

shop on the following day to see what the casting looked like in the lathe. Those fellows you read about who are rescued just as they are going down for the third and last time had nothing on me when I saw that shining cylinder whirling around and looking like a shaft of refined gold.

"The master mechanic came along while I was standing gazing in admiration at the work of art. He stopped also and said, 'Well, Bill, I see you caught the jinx and nailed his quivering hide to the fence.'

"'Yes,' I said, 'but believe me this jinx hunting business is no game for a man with a weak heart, me for the wild African desert next time."

How and Why in Brass Founding

By Charles Vickers

Casting Nickel Silver

We are casting nickel silver of compositions varying from copper, 50 per cent; zinc, 25 per cent; nickel, 25 per cent to the lower grades consisting of copper, 55 per cent; nickel, 18 per cent; zinc, 22 per cent; lead, 5 per cent. We have had fair success, but there appears to be some oxidation and we would like to learn of a suitable deoxidizer to promote sound castings.

Also how should the metals be charged into the crucibles? What will produce the best results in melting, coke, oil, or gas fuel? What type of gates are best to use to run the castings? Will bottom-pour crucibles produce the best results? What is the best skimming devise to use? Can scrap metals be used?

To make nickel silver, first charge the nickel into the bottom of the crucible, and place some pea-size charcoal on top. Then place on this the copper and scrap until the crucible is filled. Use a deepener on top of the crucible to get all the charge into the crucible while cold. After all the metal has been charged place a covering of charcoal on top and a small handful of borax. Now melt, and melt rapidly, there must be no soaking in the fire; the furnace whether coke-fired, oil-fired or gas-fired that will melt the most cleanly and quickly is the best for the purpose. When the metal is melted hot, add the zinc gradually. If the alloys are intended for rolling purposes, it is not advisable to use all scrap metals, as the sheets will crack; but rather use at least 50 per cent new metals, and while melting, keep the poker away, have plenty of heat so the mass of metal will quickly liquify. As a deoxidizer use 0.25 per cent of manganese copper.

It is not possible to offer suggestions regarding the method of gating unless the shape of the castings is known. Common sense will suggest the gates be large enough to get the metal into the mold rapidly enough to run the castings. Further they should be disposed with a view of preventing the entrance of dross, sand and other dirt into the castings. Bottom-pour crucibles will not produce the best results, because the tube leading to the bottom of the crucible never reaches sufficiently near the bottom to do any good. Usually, the tube terminates half way up the crucible side, and is a delusion and a snare. The small size of the hole also, makes it impossible to pour the molds rapidly enough, as the metal dribbles out, then overflows the top of the crucible is tipped in an effort to get results. Bottom-pour crucibles to be of value, must be made especially to blueprint, in which case they give excellent results.

The best skimming device is a common piece of band iron, bent to a crook at the skimming end, and used by a skilled, careful man.

Nickel Castings Show Pin Holes

We would like to learn of a method of making nickel silver castings come solid as the castings we make of this alloy frequently are filled with pin holes. As a source of nickel we use spent bullets after the lead is run out, and mix in the following proportions: Bullet shells, 26 pounds; cartridge, 303; brass, 12 pounds; zinc, 1½ pounds, and lead, 2 pounds. This makes a mixture that is white and otherwise satisfactory. We use gas coke for melting.

The composition of this metal is approximately, copper, 70.30 per cent; nickel, 12.52 per cent; zinc, 12.30 per cent, and lead, 4.80 per cent. To 100 pounds add 4 ounces of 30 per cent manganese copper as a deoxidizer. If this is not available and the castings are not intended to withstand pressures add one ounce of aluminum per 100 pounds of the alloy. In melting the alloy use a flux of fluorspar and lime; 3 parts fluorspar to one part lime, and if this makes the flux too fluid decrease the fluorspar and increase the lime.

Care Is Necessary with Phosphor Bronze

We are submitting for inspection a fractured section from a 1-inch cast bar of bronze of the composition following: Electrolytic copper, 90 pounds; Straits tin, 10 pounds; 15 per cent phosphor copper, 6 pounds. The alloy was made in a coal-fired furnace at a temperature of approximately 2200 degrees Fahr. Charcoal was used as a covering and the phosphor copper was added about five minutes before the crucible was pulled. The pot then was skimmed, and to cool it to a temperature of about 1850 degrees Fahr., which was considered proper for pouring, a gate of the same metal was added. During the five or 10 minutes the metal was being cooled, the surface was left exposed to the atmosphere. Green-sand molds were used. The phosphorus is purposely high, as the specifications calls for from 0.6 to 0.9 per cent of it.

The temperatures were taken with a pyrometer, and it was noted that the metal after being drawn from the furnace and skimmed and stirred, read about 100 degrees hotter than when measured in the furnace. This peculiarity has been noted on other occasions and does not appear to be due to an inaccuracy in the readings. After the metal has solidified in the molds, a small quantity of tin seems to ooze or bubble through the top of the gate. Is this tin thrown out of the solution, and if so what is the cause of this?

Will you kindly advise as to the precautions to be taken in order to secure a sounder and more uniform structure, stating temperatures, proper time for adding the phosphorus, etc.? We will thank you for an early consideration of the matter.

The composition of this alloy is as follows: Copper, 89.71 per cent; tin, 9.44 per cent; phosphorus, 0.85 per cent. This agrees closely with the formula for a bearing alloy given by A. Philip several years ago before the British Institute of Metals. This al-

loy also follows: Copper, 89.70 per cent; tin, 9.40 per cent; phosphorus, 0.78 per cent; total, 99.88 per cent. The properties of this alloy are given as follows: Tensile strength, 45,248 pounds (20.2 tons) per square inch; elongation, 12 per cent.

The alloy is used as a bearing metal because when this amount of phosphorus is present in an alloy, a compound of phosphorus and copper is formed containing three atoms of copper to one of phosphorus, or about 86 per cent copper and 14 per cent phosphorus. Anyone who has used 15 per cent phosphor copper knows this compound is hard and brittle; it is scattered throughout the mass of the alloy as hard nodules upon which the bearing may ride, thus the alloy is suitable for bearings because it resists abrasion owing to its hardness. Such metal to get a perfectly even bearing surface has to be perfectly fitted to the shaft that revolves in it. It will not give and come to a bearing like a plastic bronze; if not well fitted it will run hot, therefore, it can only be used in situations where a perfect fitting of bearing to shaft is possible. The alloy is one to cause difficulties in foundry work, due to the fact the phosphorus is too high for the percentage of tin. An alloy containing approximately 10 per cent of tin, is at its best when merely a trace of phosphorus is added. Thus 0.10 per cent of a 15 per cent phosphor copper added to such an alloy will give higher physical properties in test bars than 0.25 per cent phosphor copper and 0.25 per cent phoshor copper than 0.5 per cent phosphor copper, and so on. Foundry difficulties arise from the fact that when two or more copper hardening elements, such as tin and phosphorus are present in an alloy of copper, it becomes necessary to adjust the two, so there is room for both, otherwise, one will be crowded out as the temperature falls. Thus when enough phosphorus to form copper phosphide is added to an alloy of 10 per cent tin a rich alloy of copper-tin-phosphorus will be squeezed out as the alloy has solidified.

In the case of an alloy consisting of copper, 88.55 per cent; tin 11 per cent; phosphorus 0.45 per cent, the composition of the beads of metal that oozed from the risers was as follows: Copper, 79.13 per cent; tin, 19.99 per cent; phosphorus, 0.34 per cent. The effect of other impurities is similar. Beads of alloy are squeezed out as the casting solidifies, which may contain up to 30 per cent tin, with a relatively large amount of the impurity.

In this case, the sample submitted is far from being homogeneous in structure. It consists of a mechanical mixture of two alloys, one of a coppery color, the other much lighter. Evidently the alloy has split up while cooling and the two alloys have intimately mixed. The question arises whether this is the best alloy for the purpose If this is decided in the affirmative, then it must be cast in such a manner that no time is given for either the formation of two alloys, or for the rich copper-tin constituent to liquate.

The sample submitted is from a bar one inch diameter, cast in sand. There should be no difficulty in casting such bars in graphite molds, which would ensure quick chilling and metal of superior strength and qualities. Varying the pouring temperatures and method of making the alloy has little influence upon the structure of the alloy. The present practice is good and difficult to improve upon. It is a case of either changing the alloy itself, or the method of casting the same.

Difficulties With Nickel Alloy Castings

We have experienced considerable trouble while making castings of a mixture containing 20 parts nickel; 12 parts copper, and 3 parts phosphor tin. When the castings are turned, we find blow holes. We first run the alloy into ingot, then remelt the same for castings. We shall be pleased with any suggestions you may offer.

Figured in percentages the alloy given would consist of nickel, 57.13 per cent; copper, 34.30 per cent, and phosphor tin, 8.57 per cent. If the proportions have been correctly given this is a peculiar alloy. Assuming that the phosphor tin contains 5 per cent phosphorus, there would be 0.4285 per cent of this element added. With this composition, the addition of other deoxidizing elements is out of the question. This would only complicate the situation as the reverse of an improvement could be anticipated. If the composition of the alloy as figured in percentages is correct, and no change can be tolerated in the proportions of nickel, copper and tin, the best course would be to substitute ordinary tin for the phosphor tin, thus omitting the phosphorus entirely. In place of the phosphorus, add 1 per cent of manganese copper containing 30 per cent manganese, thus adding 0.30 per cent manganese. The manganese copper should take the place of an equal amount of ordinary copper. If the manganese fails to produce sound castings, omit the phosphorus, and shortly before removing the metal from the furnace add as a deoxidizer, 2 ounces of magnesium. It will be advisable to use a phosphorizer to introduce the magnesium, and to stir it into the alloy before withdrawing the phosphorizer. The following alloy is very stiff, also white in color. The alloy follows: Copper, 65 per cent; nickel, 32.25 per cent; aluminum, 2.50 per cent; manganese copper, 0.25 per cent.

Crucible Making Deemed Impractical in Shop

We would like to obtain information for making crucibles in order to make our own crucibles for melting brass.

The quality of the clay is important in making crucibles. Such a clay as Klingenberg is suitable. The clay is finely ground, mixed with water and allowed to stand for 24 hours. To every 1000 pounds of Klingenberg clay is added 1550 pounds of Ceylon graphite and 375 pounds of granular quartz, having a grain size of 0.08 inches diameter. The graphite and the clay must be thoroughly mixed and kneaded, then the sand is added. The mixing of the various ingredients is exceedingly important, and when mixed the clay is made into batches which are stored in cool, damp cellars to gain plasticity. The clay is then passed through a sausage machine. The strings are balled up again and are made into molds on a potter's wheel. After shaping the crucibles are dried slowly, and finally they are burned in a special kiln.

The manufacture of crucibles is a highly specialized industry. No foundry can afford to attempt to make their own, even at present high prices. We suggest that crucibles be purchased from the makers, and no attempt be made to construct them in a foundry.

Metal Like Aluminum

Will you kindly advise us where we can obtain a metal that can be handled like aluminum; one that has the same color, and properties, but which will cost less. We make a small can opener and find that aluminum makes an attractive handle, but the cost of that metal is too high. What we want is a cheap alloy with a nice appearance which will not require a finish of any kind in the way of enamel, etc.

We would suggest the use of a zinc base alloy for the purpose outlined in the query. An alloy of zinc 84 per cent; copper 10 per cent, and aluminum 4 per cent would be suitable. This alloy has much the appearance of aluminum, takes a high polish, is hard and in every way suitable for the handles such as you have been making.

Electrical Melting Of Alloys—XII

Efficient Operation is Measured by Continuity of Output — More Power Needed Per Ton Melted When Furnace Cools Between Heats— Cost Per Kilowatt Hour Lower in Large Installations

BY H. W. GILLETT

AFTER selecting a suitable type, make and size of electric brass furnace for the work in hand and properly installing and locating it in the shop, the next problem is to operate the furnace to best advantage. One feature is prominent in such operation. Everything that tends toward increasing the production from a given furnace tends to reduce the melting cost per ton. Everything that tends to decrease production tends to increase the cost.

Continuous, 24-hour operation is required to allow any electric furnace to show its maximum efficiency. Probably no firm melts brass that cannot do it more cheaply in some electric furnace than by any other means, if its production can be spread over the whole 24 hours. Most electric furnaces will produce in 24 hours more than three times what they can produce in 9 hours. In 16 hours they can produce at least twice what they can in 9 hours.

By operating two or three shifts instead of a single shift, $10,000 worth of equipment will do the work of $20,000 or $30,000 respectively, and the interest and depreciation charges per ton disappear accordingly. Fortunately, the traditions of the wrought brass industry favor night work, since the old pit fire was not so bad to handle at night as in the hotter day time.

Castings made in simple sand molds, such as railroad car bearings, can generally be made well on a night shift, but as the complexity of a sand mold increases, the disadvantages of night molding increases. The difficulties are primarily those of illumination which can be overcome, and of lack of trained foremen and superintendents for night work. If the night shift is a steady thing instead of merely an irregular one when a spasmodic need for production calls for it, there is no reason why the problem of superintendence should be insurmountable. At any rate, from the point of view of melting, continuous operation, or at least two 8-hour shifts, is attractive. Not only does this lengthened operating time cut the interest charge, but it lowers the power cost per ton, and does it in several ways. First, it decreases the idle time in which the furnace cools off, so that the first heat after an 8-hour idle period is faster and takes less power than after a 15-hour idle period. In this way the extra power required to make up for lost heat becomes a smaller percentage of the total used and thus, the power used per ton is less.

Moreover, the power that is used costs less per kilowatt hour because power contracts contain two factors, the demand, and the energy charge. The demand charge is based on the maximum load, and is a sort of interest charge to pay the central station for setting aside part of its generating equipment for its customers' use. Obviously, the central station needs only half as much equipment to supply 300 kilowatts to one furnace, whether it is used one, two, or three shifts, as to supply 600 kilowatts to two furnaces at the same time. The power factor penalty or premium carried by many power contracts is analogous, a low power factor means that just so much more of the central station's generating equipment is tied up.

The other factor, the energy charge, pays for coal, labor, depreciation, etc., which vary with the amount of power supplied. The more power used, the less is charged for each unit of the added increment. In other words, one gets power cheaper by buying in large quantities. Hence, it may happen that the cost of power for a single electric furnace might be too high to allow that furnace to show a saving, while by going more completely over to electric melting, and installing several furnaces, the cost of power might drop so that the battery of furnaces would show a saving. This will be made clearer by including a computation which the writer has already given elsewhere*. Similar points have been brought out by Berlin** for steel furnace operation. Suppose there is a maximum demand of 300 kilowatts and that the average power consumption per ton of metal is 335 kilowatt hours per ton on 9-hour operation, 275 on 18-hour and 250 on 24-hour operation; the total power used per day is then about 2000, 3575 or 5250 kilowatt hours for the three cases figuring 8, 13 and 21 heats a day respectively. In a 25-day month this means 50,000, 90,000 or 131,000 kilowatt hours per month.

Assume that the plant, before it installed its electric furnace equipment, had a maximum demand in lights and motors of 200 kilowatts, and used 20,000 kilowatt hours per month for those purposes. Taking a concrete case where the power contract calls for a demand charge of $1.80 per kilowatt per month for the first 50 kilowatts and $1 per kilowatt per month, for all over 50 kilowatts, and where the energy charge schedule is 2 cents per kilowatt hour for the first 2500 kilowatt hours per month, 0.8 cent per kilowatt hour for the next 35,000 kilowatt hours per month; 0.5 cent per kilowatt hour for the next 310,000 kilowatt hours per month and 0.4 cent per kilowatt hour for all over this amount per month.

The 200 kilowatt hours for lighting and motor power cost as follows:

50	x	$1.50	=	$ 75.00
150	x	1.00	=	150.00
Demand	charge		=	$225.00
2500	x	$0.02	=	$ 50.00
17500	x	0.008	=	140.00
Energy	charge		=	$190.00

Total $415, or 2.075 cents per kilowatt hour used.

With the 300-kilowatt furnace the plant has 500 kilowatts maximum demand, and 70,000, 111,000, 150,000 kilowatt hours are used per month on the three assumptions. These will be figured as follows:

50	x	$1.50	=	$ 75.00
450	x	1.00	=	450.00
Demand charge			=	$525.00

Energy—Case No. 1

2,500	x	$0.02	=	$ 50.00
35,000	x	0.008	=	280.00
32,500	x	0.005	=	162.50
70,000	Total kilowatt hours used.			492.50 Energy charge.
				525.00 Demand charge.
				$1017.50 Total charge.
Less previous charge for lights and motors				415.00
Total charge for electric furnace power				$ 602.50

$$\frac{602.50\text{—total charge}}{50{,}000\text{—kilowatt hours used}} = 1.205,$$ shows the electric furnace power cost to be 1.205 cents per kilowatt hour.

*Gillett, H. W., Utilization of Electric Brass Furnaces, Jour. Ind. Chem. Eng., Vol. 11, 1919, p. 664.

**Berlin, W. G., Power Problems from the Point of View of the Furnace Operator, Trans. Am. Electrochem. Soc., Vol. 37, 1920, p. 367.

In case No. 2 the demand charge is the same but the energy charge is:

2,500 x $0.02	=	$ 50.00		
35,000 x 0.008	=	280.00		
72,500 x 0.005	=	362.50		
110,000 Total kilowatt hours used.		692.50	Energy charge.	
		525.00	Demand charge.	
		$1217.50	Total charge.	
Less previous charge for lights and motors		415.00		
Total charge for electric furnace power		$ 802.50		

$$\frac{802.50\text{—total charge}}{91{,}000\text{—kilowatt hours used}} = 0.89, \text{ shows}$$

the furnace power cost to be 0.89 cent per kilowatt hour.

In case 3 the demand charge is also the same, but the energy charge is:

2,500 x $0.02	=	$ 50.00	
35,000 x 0.008	=	280.00	
113,500 x 0.005	=	567.50	
151,000 Total kilowatt hours used.		897.50	Energy charge.
		525.00	Demand charge.
		$1422.50	Total charge.
Less previous charge for lights and motors		415.00	
Total charge for electric furnace power		$1007.50	

$$\frac{1007.50\text{—total charge}}{131{,}000\text{—kilowatt hours used}} = 0.77, \text{ shows}$$

the furnace power cost to be 0.77 cent per kilowatt hour.

And if, in case 4, the plant had three times the furnace installation figured previously, and used it 24 hours a day, it would have 900 kilowatts furnace demand (1100 kilowatts total) and 450,000 kilowatt hours per month furnace energy (470,000 total). The charge would then be figured:

50 x $1.50	=	$ 75.00	
1,050 x 1.00	=	1050.00	
		$1125.00	Demand charge
2,500 x $0.02	=	50.00	
35,000 x 0.008	=	280.00	
310,000 x 0.005	=	1550.00	
122,500 x 0.004	=	490.00	
470,000 Total kilowatt hours used.		$2370.00	Energy charge
		1125.00	Demand charge
		$3495.00	Total charge
Less previous charge for lights and motors		415.00	
Total charge for electric furnace power		$3080.00	

$$\frac{3080.00\text{—total charge}}{450{,}000\text{—kilowatt hours used}} = 0.68, \text{ shows}$$

the electric furnace power cost to be 0.68 cent per kilowatt hour.

The conclusions from these four cases are shown in the accompanying Table II. This table illustrates the advantage of continuous operation of electric furnaces, as well as the benefit derived from large installations. The exact figures will vary in each particular case, but the ratios will remain approximately the same.

After one electric furnace is in use, the installation of more is increasingly attractive up to the point where the normal production of the shop is electrically melted. However, on account of the initial cost and the interest charge, electric furnaces, as a general rule should not be provided to handle small peaks of production in excess of the normal. A fuel-fired furnace of lower initial cost should be utilized for this purpose.

Sometimes the power cost can be reduced in another way. Many central stations would be glad to improve their load factor, that is, instead of having all their generating equipment overloaded in the rush hours with their *peak load*, and almost idle from midnight to morning, they would like to keep it at all full load all the time. Such stations—and each one has a different time of the day and year for its heaviest peak loads—would be glad to sell off-peak power at a material reduction over ordinary power. That is, if the foundry will agree not to run its electric furnaces, for example, between 3 and 5 p. m. December to March, or between 4 and 6 p. m. the rest of the year, power will be supplied at any other time at a price lower than the regular schedule*. Therefore it is well to ascertain from the central station just what its power schedule will be under various conditions, since it may be possible to work out an operating schedule to fit, at a considerable saving in cost of power.

Whether it is possible to operate more than one shift per day or not, it is always important to keep operating during the entire scheduled time. The furnace should be kept actually melting metal with as short idle periods for charging and pouring as possible. Mechanical charging, where the furnace design makes it practical, and rapid pouring, preferably into a few big ladles instead of into a lot of small ones, especially when the metal has to be held in the furnace waiting for the first ladles to come back from the other end of the foundry, play a large part in enabling the furnace to do a lot of work and do it cheaply.

Mechanical charging in electric steel furnaces is termed by Styri** "an essential element in the economy of operation," and he suggests a redesign of the heroult steel furnace to permit charging it mechanically. When the ad-

*Compare Richards, J. W., and Crosby, E. L., Discussion, Trans. Am. Electrochem. Soc., Vol. 25, 1914, pp. 151, 153.

**Styri, H., The Electric Furnace in the Development of the Norwegian Iron Industry, Trans. Am. Electrochem. Soc., Vol. 32, 1917, p. 224.

TABLE II

Figures From Different Operating Conditions

Case No.	1	2	3	4
Hours of furnace operation	9	18	24	24
Number of furnaces	1	1	1	3
Kilowatt hours per ton	335	275	250	250
Furnace, power price, cents per kilowatt hour	1.205	0.89	0.77	0.68
Cost, dollars per ton for power	4.04	2.45	1.93	1.70

TABLE I

Records Of Heats As Run And As They Might Have Been Run

Heats as Run

Heat	Charge lbs.	Total time hours and min.	Arc on hours and min.	Idle time hours and min.	K. W. hours used	K. W. hours per 100 lbs.
1	497	2:45	2:05	40	211	*42
2	522	1:45	1:25	20	130	25
3	527	2:55	1:10	1:45**	105	20
4	523	1:25	1:05	20	106	20
5	394	1:25	1:10	15	94	25
Total	2463	10:15	6:55	3:20	646	Av. 26

Average shows 520 kilowatt hours per ton.

As They Could Have Been Run by Eliminating Delays

Heat	Charge lbs.	Total time hours and min.	Arc on hours and min.	Idle time hours and min.	K. W. hours used	K. W. hours per 100 lbs.
1	525	2:10	1:55	15	215	41
2	525	1:40	1:25	15	130	25
3	525	1:25	1:10	15	105	20
4	525	1:20	1:05	15	100	19
5	525	1:20	1:05	15	100	19
6	525	1:20	1:05	15	100	19
Total	3150	9:15	7:45	1:30	750	24

Average shows 480 kilowatt hours per ton.

*Furnace at red heat from previous day's run.

**Delay waiting for molds.

vantages of a high rate of production are thoroughly impressed on the furnace users, the next obvious step, preheating the charge by fuel and finishing the heat in the electric furnace, will undoubtedly be tried out. Under many conditions this would be more trouble than it would be worth, but under other conditions it should show a marked saving in melting cost.

Again, the higher the rate of power input, within the limit the refractories will stand, the better because of the greater production as well as increased efficiency secured. Suppose a furnace takes 100 kilowatts and loses 35 kilowatts through shell radiation and electrode losses, then 65 kilowatts do useful work. If the same furnace is given 125 kilowatts it may lose 37½ kilowatts in shell and electrode losses, but 87½ kilowatts do useful work. The furnace will do one-third more work in a given time at the higher rate. Automatic electrode control will maintain a high input more steadily than hand control, on furnaces where either can be used, and thus tends to decrease power consumption per ton of metal melted as well as to lower labor cost.

Another source of loss in efficiency is heating the metal hotter than is necessary. Every degree of needless superheat consumes power and time. Holding the metal in the furnace waiting for molds can be done in most electric furnaces without injury to the metal, but the delays thus caused raise power consumption, lower output, and increase melting costs.

The importance of eliminating all possible sources of delay can be best illustrated by an actual example. Take the run on a small Rennerfelt furnace on red brass illustrated in Table I. Any type, make, or size furnace on any alloy would show the same general condition. The results show the elimination of delays gives a 25 per cent increase in output in an hour less time, at 40 kilowatt hours less per ton. As St. John* points out, an accurate furnace record, or log, is of great value in showing the amount of avoidable delay and its causes.

For a furnace to stand idle, as when waiting for a charge, or to be kept holding the metal while waiting for molds or for the ladle crane, cuts down its production. Such delays will occur, but the more often they occur, the farther will be the furnace performance from its maximum. There is, of course, a point where insistence on purely furnace efficiency, as differentiated from the total efficiency of the shop, will reduce its real efficiency, measured in dollars and cents. But, because the cost of electric power and the interest charges on a large investment, melting costs in electric furnaces show greater savings between careful and careless operation than do fuel-fired furnaces. Therefore electric melting will repay careful supervision to keep it near the standard. Perhaps the most potent method of creating the proper impression in the shop and making anything that would delay the furnace unpopular, is to pay the furnace tender a bonus for production which is large enough to make him anxious to earn it.

*St. John, H. M., Commercial Testing of Metallurgical Electric Furnaces, Chem. and Met. Eng., Vol. 21, 1919, p. 281.

Records should be kept of furnace operations, so that any inefficiency is readily noticed. Keeping such records is made possible by providing each furnace with its own kilowatt-hour meter, instead of merely having one such meter for all the power used in the plant. These meters may not be needed on the induction furnace, which has so steady a load that heats may be brought out on a time schedule. Other furnaces are best run on a kilowatt-hour schedule. After a few test runs one can make out a definite schedule of kilowatt hours needed on each heat for any particular furnace, with any particular alloy, definite proportion of ingot, scrap, and borings, and any given weight of charge. In 9-hour operation the kilowatt hours per heat will be higher in the morning and approach or reach a lower constant figure at the end of the day.

By adhering to such a schedule and running on kilowatt-hour input instead of on a time schedule at a supposedly constant but actually variable kilowatt input, the heats can be brought out with astonishing regularity as to temperature. The kilowatt-hour meter is as important as the speedometer on a motor car or truck. Not all furnace makers supply them, but each furnace should have one.

The efficient operation of an electric furnace is in many ways much like that of a motor truck. The more hours a day it is used, the fewer the stops, and the more heavily loaded, up to its capacity, the lower the cost per ton mile for the truck and per ton output for the furnace. If gasoline were distinctly cheaper when bought in large quantities, as power is, the analogy could be carried still farther.

Since conditions for most rapid production in electric furnaces are the conditions for lowest melting cost, it is plain that it is the larger firms having the most need for production, that are in the best position to utilize the advantages of the electric furnace as well as to finance their high first cost.

However, the many successful installations in rather small foundries indicate that the big companies are not the only ones who can save money by electric melting. The small firm that has power available at not too high a cost can often effect a saving if it chooses a suitable type of electric furnace, installs it properly, and operates it at its maximum efficiency. However, if the furnace is not operated properly it can in a good many cases, quite readily lose money. Careless operation may easily increase the total melting cost in a small furnace by half over what the furnace maker can demonstrate the cost can be brought to under ideal operating conditions.

Careful operation is important even in the largest shops, but there is usually so much leeway between melting costs in fuel-fired and electric furnaces in such shops that the cost sheets still look well compared with the old ones. In the small jobbing shop that is on the border line as to cost of melting by fuel and by electricity, careless operation is likely to turn a possible saving into an actual loss.

This series of articles has so far been based on electric brass furnace conditions as they are today. The next and last article will consider what those conditions are likely to be in the future.

Fluorspar Production

The United States geological survey reports, from figures received from the principal producers of fluorspar, that the total shipments from domestic mines in 1919 amounted to approximately 122,000 short tons valued at $3,102,000, as compared with 263,817 tons valued at $5,465,481 in 1918. The shipments of gravel spar, the grade used principally for flux in the manufacture of open-hearth steel, amounted in 1919 to about 110,000 short tons as compared with 236,121 tons in 1918. The import of fluorspar into the United States in 1919 were 6943 short tons as compared with 12,572 tons in 1918.

Plans to Build Foundry

The Melrose Park grounds of Providence, R. I., have been purchased for the Whitins Machine Works of Whitinsville, Mass., and plans are being considered for the erection of a series of buildings and the establishing of a large modern foundry plant.

S. H. Cleland recently was appointed eastern sales manager with temporary offices at 15 East Fortieth street, New York, for the National Engineering Co., Chicago, manufacturer of foundry equipment including the Simpson sand mixer.

Fig. 1—An installation of swing frame grinding machines

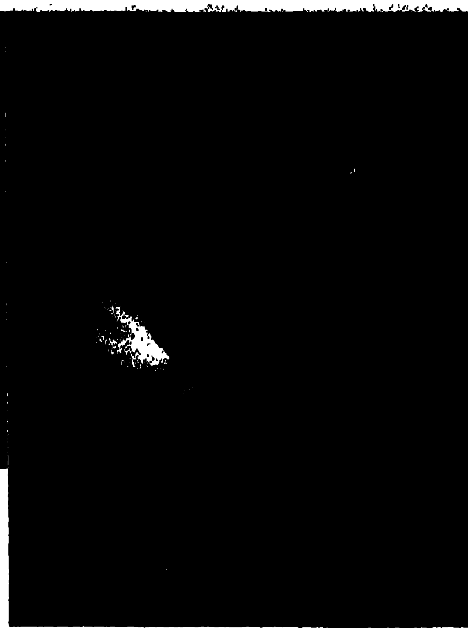


Fig. 2—Close-up showing the operator snagging a bucket

Grinding Manganese Steel

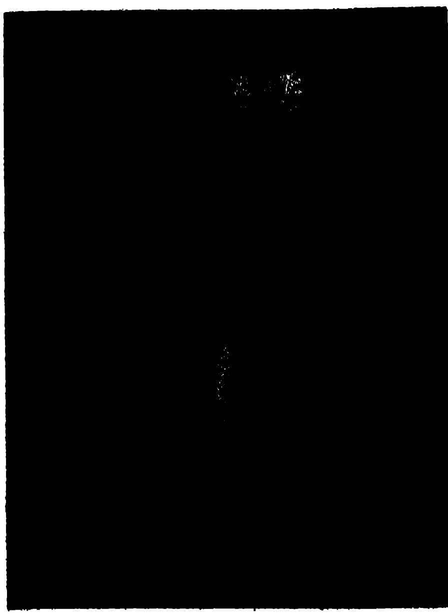
BY R. M. JOHNSON

ALLOY steels are of unusual interest, not only because of the large number of different combinations of properties that can be obtained, but also because of the increased efficiency of these comparatively new steels. Carbon steel is really an alloy steel, but when we refer to this class we mean steel to which has been added some of the less common metals such as tungsten, vanadium, molybdenum, nickel, manganese, and chromium. Possibly not the most important, but surely one of the most interesting of these, is manganese steel containing manganese in quantities from 12 to 14 per cent. The steel, although discovered by Robert Hadfield in 1886, did not come into prominence until about 25 years ago. And it was even later when its great commercial value was realized. Up to the time it was discovered, all metals that were hard enough to resist abrasive wear were so brittle that they could not be used for many parts. Chilled iron is very hard, but very brittle and comparatively weak. Hardened tool steel is stiff and easily broken under shock. Manganese steel is hard and also very tough.

From a recent issue of *Grits and Grinds*, published by Norton Co., Worcester, Mass.

This property of toughness with hardness is obtained only after the manganese steel castings are heat-treated. When cast and allowed to cool slowly the castings are hard, but also very brittle. After removing from the molds the castings are heated and quenched in cold water. The resulting casting is hard, tough, and so malleable that it can be drawn into wire, rolled, and forged. When in the brittle unannealed condition, the risers and sprues can be broken off. After annealing, the casting can not be commercially machined with any steel tool now known, but must be ground. If a keyway is to be cut or a hole tapped, soft steel inserts are set in the molds and the metal cast around them.

The uses for manganese steel are practically without limit. In general



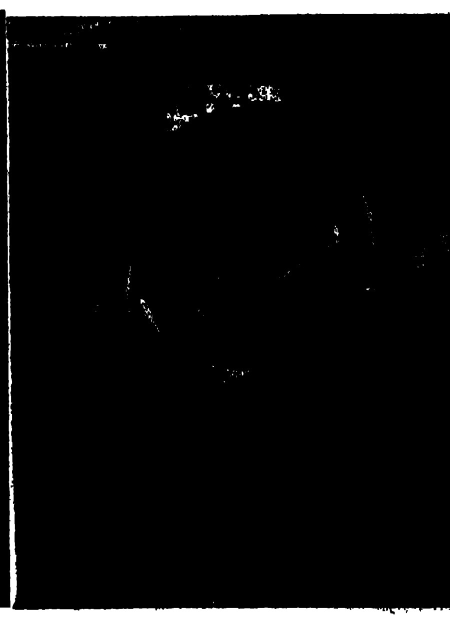


FIG. 3—FINISHING THE PERIPHERY OF A CRANE WHEEL ON A CYLINDRICAL GRINDING MACHINE FIG. 4—GRINDING PIPE BALLS—A VERY SEVERE OPERATION FIG. 5—GRINDING A SIDE LINER 8 FEET 7½ INCHES DIAMETER FOR A CENTRIFUGAL PUMP

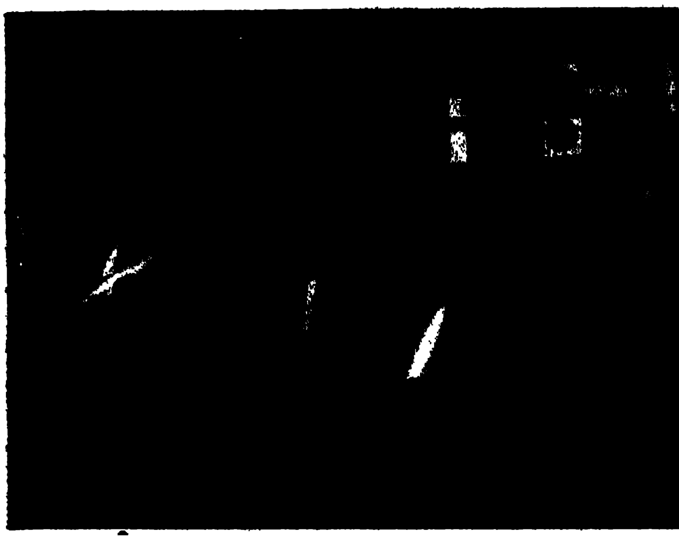



FIG. 6—STATIONARY GRINDING STANDS PROVIDED WITH ADEQUATE SAFETY FEATURES FIG. 7—SURFACING CRUSHER SEGMENTS ON A SURFACE GRINDING MACHINE OF THE PLANER TYPE

where moving parts are constantly exposed to gritty dust, manganese steel castings give excellent service. Possibly an enumeration of some types of machinery in the construction of which this still is used will be interesting; crushing and pulverizing machinery for ores, coal, slag, and cement; clay working machinery; emery mill rolls; buckets, chain, and sprockets for bucket elevators; corrugated rolls, segments, gears, and pinions of coal crushers for wire ropeways; wearing parts of steam shovels, dredges, and ditching machinery; and centrifugal pumps. Manganese steel is also used for crossings, frogs, switches, and guard rails; for tractor links and sprockets; for gears and pinions commonly used in steel mills; and for safes.

A typical analysis for manganese steel is: Carbon, 1.25 per cent; silicon, 0.3 per cent; manganese, 12.5 per cent; sulphur, 0.02 per cent and less; phosphorus, 0.08 per cent.

In connection with the use of manganese steel sheaves an important property is brought to light. Cast-iron sheaves require frequent renewal. Particles of grit become imbedded in the groove, metal particles work into the rope, scoring the groove and in time cutting the rope. It is claimed that manganese steel sheaves wear smooth and as a result the ropes sometimes last 100 per cent longer. Because of the increased strength the sheaves many times can be made 30 to 50 per cent lighter in weight.

Castings Offer Severe Tests

Grinding manganese steel, either snagging or semiprecision is a very severe operation. Chisels cannot be used for removing the heavy fins and burrs from the rough castings. They must be broken off with sledge-hammers before annealing or cut off with an oxyhydrogen or oxyacetylene torch. Whichever method is used, the castings are very rough and jagged when they come to the cleaning room.

Fig. 1 shows an installation of swing frame grinding machines. Attention is called especially to the excellent construction of the machines, which are rigid, have plenty of power and are suspended from one point giving universal movement. The work shown is the rough snagging of gold dredge buckets, nose pieces for these buckets and rock crusher parts. Fig. 2 shows a close-up view of one of the swing frame machines snagging a gold dredge bucket.

Fig 8 shows a ½ x ¾ x 9-inch wheel mounted on a flexible shaft machine, snagging a crane wheel.

For snagging operations such as these, the grinding wheel must be free cutting. At best, considering heat is developed when manganese steel is ground, slow cutting wheels increase heat and increase the possibility of breakage. Hard wheels heat and cut slowly; soft wheels are cool cutting, grind rapidly, and of course wear faster than the hard

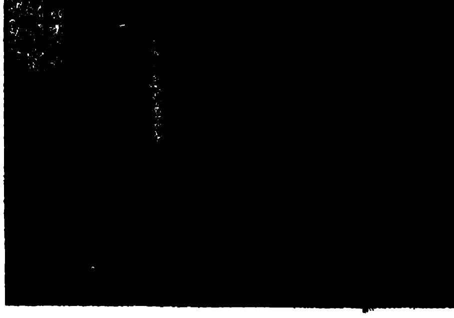
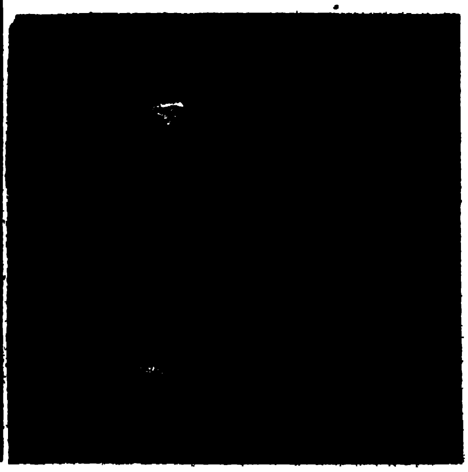



FIG. 8—WHEEL MOUNTED ON A FLEXIBLE SHAFT SNAGGING A CRANE WHEEL FIG. 9—SPECIAL LATHE FOR GRINDING SAFE DOORS FIG. 10—SPECIALLY DESIGNED MACHINE SHOWN IN THE ILLUSTRATION GRINDING THE ENDS OF BALL MILL PLATES USED IN A CEMENT-GRINDING MACHINE

wheels. There is a grain and grade which gives maximum results when considered from all angles.

A cylindrical grinding machine used for finishing the periphery of crane wheels is shown in Fig. 3. An 8 x 2 x 18-inch wheel running at 6500 surface speed per minute is used. The work revolves at 32 revolutions per minute, a surface speed of 100 feet per minute. A fillet is ground on both sides of the tread, the wheel being fed straight in.

Fig. 4 shows another cylindrical operation, grinding pipe balls. The wheel speed is 6500 surface speed per minute, work speed 200 surface speed per minute, feed 0.010 inch, table traverse 108 inches per minute. The part ground is 11 inches in diameter by 6 inches long. This operation is very severe on the grinding wheel; it must cut rapidly or the wheel wear is excessive. A 2½-inch wheel is used.

A special lathe which can be rigged for all kinds of work is shown in Fig. 5. The picture shows an 8-foot 7⅛-inch diameter suction side liner for a centrifugal pump being ground with 1¾ x 2 x 14-inch vitrified wheel. A work speed of 300 feet per minute is used.

Fig. 10 is a specially designed machine for surface grinding and is called a pit grinding machine. It mounts four 1½x 1¾ x 10-inch wheels. The picture shows the machine being used for grinding the ends of ball mill plates used in a cement grinding machine. The traverse is 144 inches per minute.

Another surface grinding machine, a planer type, is shown in Fig. 7. It is being used here for surfacing crusher segments. The wheels are 1½ x 2 x 10-inch. The table traverse is 240 inches per minute.

The manufacture of manganese steel safes is an interesting process. The rough castings are snagged in the cleaning room. The door hole in the safe is ground internally on a lathe. Fig. 9 shows a special lathe used for cylindrically grinding the safe doors. The work speed is about 20 feet per minute. After the door and the door hole have been ground to practically the same size, abrasive grain mixed with oil is placed on the bearing surface and the door lapped in until the safe is absolutely air tight.

Open Sand for Making Gear Teeth

Question.—We are making fairly heavy gear wheels up to 12 inches in diameter, and experience considerable trouble on account of the sand burning into the teeh. We will appreciate any information you can give us on how to avoid this trouble, the proper kind of sand to use, the best way to ram the teeth and the most efficient equipment for making these gears in quantity production.

Answer.—Mix coal dust with your facing sand in the proportion of one part of coal dust to eight parts of sand; that will cause the sand to peel off the teeth and leave them clean. A medium coarse grade of sand is necessary to make satisfactory gear wheels. If fine sand is used it will cause trouble in two ways. If it is rammed hard it will cause the teeth to buckle and scab, and if it is not rammed hard enough the teeth on the casting will be swelled out of shape. The best method of ramming gear teeth is to throw the facing sand into the teeth by hand. Lay the pattern on the board or plate and, before putting on the drag flask, secure a shovelful of facing sand which has been passed through a No. 8 riddle. Take one handful of this sand at a time and keep throwing it against the teeth until all of them are filled. The flask may then be put on and rammed up in the usual way. Whether you should adopt a power or hand-ramming machine would depend on your anticipated tonnage. Any type of stripping plate machine would answer your requirements.

Survey Present Molding Sand Figures

The work done by the United States geological survey in connection with sand and gravel is not confined to the tabulation and publication of the statistics of production. Information concerning these products is constantly being sought and compiled and is freely given to any inquirer. An engineer in New York may want a grade of sand that is especially fitted for some particular work there or elsewhere and may ask what source of supply is nearest to his project. The survey promptly puts him in touch with the firm or firms that can best supply him sand in the quantity and of the quality he desires for his particular work.

Reports received by the United geological survey from 2800 producers show that 61,824,426 short tons (of 2000 pounds) of sand and gravel were produced in 1918. The importation of some special grades of molding sand, such as the French sand for making fine bronze castings and of refractory sands from England for lining certain iron furnaces, is due to the difficulty of making molders and foundrymen believe that the foreign sands with which they are familiar are no better than the sands which are found in different parts of America.

The output of six states which produced 85 per cent of all the domestic molding sand dug in 1918 is given in the accompanying table.

During 1918 the steel mills of the country were busy on war orders and a large number of foundries were working at top speed. For this probably more than for any other reason there was a heavy demand for molding sand. There was an increase of 5 per cent in the production of sand of this class over that of 1917, and the price per ton received averaged 13 per cent higher. The output was 4,910,178 short tons, valued at $5,121,865, as compared with 4,660,968 tons, valued at $4,303,809 in 1917.

Approximately 60,196,000 short tons of sand and gravel of all grades was sold in the United States in 1919, according to preliminary estimates made by L. M. Beach, of the survey.

This quantity represents a decrease below that sold in 1918 of about 1,628,000 tons. The value in 1919, however, was $37,819,000, as compared with $37,927,079 in 1918, which shows that the average price had increased. The trend in sand production is shown in the following summary covering five years:

	Molding Sand	
Year	Quantity (short tons)	Value
1915	3,585,746	$2,128,293
1916	4,602,649	3,310,839
1917	4,660,968	4,303,809
1918	4,910,178	5,121,865
1919a	3,715,000	3,510,000

Producers report that the demand for this material in 1919 was heavy but that the production was curtailed on account of car shortage.

Molding Sand Production In 1918

	1917			1918		
State	Quantity (short tons)	Value	Average price per ton	Quantity (short tons)	Value	Average price per ton
Pennsylvania	640,450	$ 696,734	$1.09	1,158,715	$ 953,886	$0.82
Illinois	703,208	412,626	.59	885,617	658,205	.74
Ohio	999,974	1,218,217	1.22	857,481	1,493,541	1.74
New York	650,,427	808,550	1.24	519,681	770,512	1.48
New Jersey	611,916	651,279	1.06	442,007	626,637	1.42
Indiana	287,483	111,732	.39	308,034	135,605	.45

THE FOUNDRY

A semimonthly journal devoted to all branches of the foundry trade

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Contents

Making the Shop Fit the Product

IN THE ordinary manufacturing plant the foundry occupies the same relative position that the kitchen commands in the home, and it must be conceded that it usually is considered by the owners in much the same light that the average man thinks of that essential domestic department. He regards it a necessity to be tolerated, but something that does not require elaborate furnishings or modern conveniences. Furthermore, the foundry, like the kitchen, is situated as far as possible from the front door with all the intervening doors carefully closed so that it may not contaminate the atmosphere of the other rooms. Its existence is admitted but politely ignored as far as possible.

The owners of a business are constantly on the alert to discover and apply new and improved methods in finishing their manufactured product, in developing and expanding their business according to modern standards, and in adopting present day publicity ideas. They take a commendable pride in keeping their office furniture and routine office work abreast of the times. Rarely do they hesitate in scrapping obsolete machinery or in building additions to their plant to facilitate the production made possible by improved mechanical equipment and methods.

The office and machine shop, corresponding to the parlor and living room, are furnished and equipped according to the style of the times, and in conformity with the prestige of the owners; but the foundry—the kitchen—is *only* the foundry and so long as a sufficient quantity of castings emerge from its mysterious depths to keep the plant running, no one seems to care. Whether the adoption of modern methods and appliances would not show gratifying results in reduced costs, increased production or both is not considered in the average shop.

Just as the location and equipment of the modern kitchen are receiving the attention they deserve, so also are manufacturers generally taking a more pronounced interest in the foundry. The same interest is evidenced in both the construction and equipment of the modern shop, and an effort is being made in most new undertakings to place the foundry on a par with the remainder of the plant.

The great strides made by the foundry industry in recent years; the marked advantages enjoyed by the large number of foundries designed and built for the specific manufacture of a definite product, as reflected in the volume of business and in their cost sheets, has influenced many manufacturers to consider seriously the erection of new foundries, designed, built and equipped in a special manner to suit their particular requirements. While it is true that foundries all are alike in their general characteristics, still there are so many details in connection with each of these operations, depending on the shape, size and other characteristics of the desired casting that a type of shop and equipment eminently suitable for one class of castings would be totally unsuitable for another. It is therefore essential that the question be given careful consideration to secure the type of building and equipment which is best adapted to the particular work. Two points in particular constantly should be kept in mind when planning either an entire new building and installation, or remodeling and rearranging the equipment in one already existing. The first point is to provide a building adequately heated, lighted and ventilated and the other is to so plan the work that there will be no duplication.

Trade Outlook in the Foundry Industry

THE cloud of prospective advances in freight rates has a silver lining for the foundryman who hopes the increase in revenue received by the railroads will enable them to provide sufficient rolling stock adequately to meet the needs of the country's industries. Almost anything which promises to give adequate shipping facilities would be welcome to the foundries pressed as they are for materials. Another slant to the rate raise is the ultimate casting business to be received by the foundries in supplying castings for new equipment.

Prices Advance

However, there is the other side of increased cost of materials. Pig iron is heavily dependent on carriers in its manufacture and the cost of its production will be materially increased by higher freight rates. It also would seem that the southern iron would be at a slight disadvantage from the change, as the hauls on these grades on the average are longer than the hauls on northern irons. Whatever the future developments may show, the present tendency is for an increase in the price of pig iron in nearly all centers. In the South some producers continue to offer No. 2 pig iron at the former price of $42 for delivery the last quarter of this year and the first quarter of next. However, the majority of the producers are quoting $44 for this iron. Iron is being stocked at the furnaces in this district owing to lack of facilities, but every effort is being made to maintain production. The eastern pig iron scarcity shows no signs of easing and most furnaces are fully booked. Current inquiry includes smaller lots for this delivery and some for first and even second quarter. Malleable demand is strong in Chicago but round tonnages cannot be covered in that market and must be sought from Ohio producers. A sale of 1000 tons from an Ohio furnace has been closed for last half delivery at $48, furnace, which brings it to about $51, Chicago, with the added haulage charge.

Production Increases

Production of pig iron for July shows an improvement of only 14,000 tons over the June output. This small increase in the total still permits a drop from the June rate of production. The total output for July was 3,060,626 gross tons, while the tonnage for June was 3,046,623 gross tons. The July production represents 98,729 tons per day, or a loss of 2824 tons from the June average of 101,553 tons. Merchant stacks made 782,596 tons compared with 769,236 tons in June, a gain of 13,360 tons. The daily average was thus 25,245 tons, which is short of the June average of 25,641 tons by 396 tons per day. Production of beehive coke increased by 18,000 tons during the week ending July 24. The total output of coke, estimated on the basis of railroad shipments was 381,000 net tons against 363,000 net tons for the week of July 17. This increased production was not felt in the consuming centers. Pittsburgh reports a shortage of coke. Quotations on prompt foundry coke hold around $19.50, while even higher prices have been paid in some instances. The coke market in Cincinnati is irregular as a result of continued shortage with a heavy buying demand. Most of the coke sold recently at $21. Increased cost of coal is bringing up the price of by-product coke in the Chicago district. A recent advance of $1 per ton seems likely to followed by another increase in the near future as the cost of production is forced upward. At Birmingham foundry coke is quoted at $12.50, although sales have been made at $15. Coal car supplies at the mines are slowly increasing and shipments grow. The car situation for materials other than coal has been helped by the action of the interstate commerce commission in amending service order No. 9 so that the phrase *coal cars* is to include flat bottom gondola cars with sides less than 38 inches in height. It is estimated that this change will release 15,000 cars for the iron and steel trade. The increase in cars promised to foundry centers will be of great help in many districts in which the call for castings is still strong. However, in the Michigan and northern Ohio district the demand for castings is markedly decreased by the reduction in output of automobiles. A slump in the foundry business also is felt in the Philadelphia territory where a large percentage of the castings made are for the shipbuilding industry. The work at the shipyards has fallen off considerably of late, at least, the number of new vessels being started is much smaller than it has been owing to the completion of government contracts and the lack of private initiative. This decrease in shipbuilding not only is felt in foundries about Philadelphia but it also affects foundries in different parts of the country which have been making marine engine castings. So far little business has come to the foundries from orders for railroad equipment.

Although the ferrous metals are little affected by the recent stir-up in Europe, the nonferrous industry is considerably disturbed by the international situation. This is felt mostly in uncertainty in future price developments. Tin fluctuated widely with the variations in exchange, but the other metals held steady. The other controlling influence in the nonferrous foundry industry is the slowing of the automobile business which is being felt. Prices of nonferrous metals based on New York quotations of Aug. 5, follow: Copper, 18.12½c to 18.25c; lead, 8.50c; Straits tin, 49.50c to 49.75c; antimony, 7.25c; aluminum No. 12 alloy, producers' price, 32.00c, and open market, 29.00c to 30.50c. Zinc is quoted at 7.80c to 7.85c, St. Louis.

Prices of Raw Materials for Foundry Use

CORRECTED TO AUG. 6

Iron	
No. 2 Foundry, Valley	$40.00 to 47.00
No. 2 Southern, Birmingham	42.00 to 44.00
No. 2 Foundry, Chicago	46.00
No. 2 Foundry, Philadelphia	48.10 to 49.10
Basic, Valley	46.50
Malleable, Chicago	46.50
Malleable, Buffalo	46.25

Coke	
Connellsville foundry coke	$18.50 to 19.00
Wise county foundry coke	19.50 to 21.00

Scrap	
Heavy melting steel, Valley	$25.50 to 26.25
Heavy melting steel, Pittsburgh	27.00 to 27.50
Heavy melting steel, Chicago	24.50 to 25.00
Stove plate, Chicago	31.50 to 32 00
No. 1 cast, Chicago	42.00 to 42.50
No. 1 cast, Philadelphia	38.00 to 42.00
No. 1 cast, Birmingham	32.00 to 35.00
Car wheels, iron, Pittsburgh	42.00 to 43.00
Car wheels, iron Chicago	37.50 to 38.00
Railroad malleable, Chicago	32.00 to 32.50
Agricultural malleable, Chicago	31.50 to 32.00

Comings and Goings of Foundrymen

FRED A. BARENDT, who succeeded James A. Murphy as foundry superintendent at the plant of Owens, Hooven, Rentschler Co., Hamilton, O., has been with the company in the capacity of general foundry foreman for several years. Previous to joining the Hamilton firm he had a wide experience in the marine engine field. He served his time with the American Shipbuilding Co., Cleveland, where he worked for more than 10 years under such competent marine men as the late G. S. Stoney, Elias Thomas and Hugh McKenzie. He was foreman of the Globe Foundry Co., a subsidiary of the American Shipbuilding Co., Cleveland, before accepting his position in Hamilton, O.

Edward J. Mulvaney has accepted a position with the Standard Engineering Works, Ellwood City, Pa.

Arthur Corbeille has assumed the management of the W. L. McCullough Foundry Co., of Ypsilanti, Mich.

P. H. Davis has resigned after 30 years service as superintendent for the Moline Malleable Iron Co., St. Charles, Ill.

E. A. Walcher has been made works manager of the American Steel Foundries plant at Granite City, Ill., succeeding W. C. Hamilton.

C. M. Campbell who until recently was metallurgist for the West Steel Castings Co., Cleveland, has been made superintendent for the Pioneer Alloy Products Co., of that city.

Charles H. McKnight, president of the Carbon Steel Co. and the Pittsburgh Iron & Steel Foundries Co., both of Pittsburgh, left recently for a two months' trip to Europe.

Frank E. Rentz, formerly superintendent of A. Allan & Co., Harrison, N. J., has been made superintendent for Sheeler-Hemsher Co., Philadelphia, maker of special alloys.

Gilbert Murray, formerly connected with the Hill Pump Works and the Mid-West Engine Co., has started on his new duties as general superintendent of the Anderson Foundry & Machine Works, Anderson, Ind.

Albert W. Walker, foreman of the foundry department of the Howard & Bulough American Machine Co., Pawtucket, R. I., has recently resigned his position to accept a similar position in Elmira, N. Y.

C. B. Fulton, for seven years with the Fawcus Machine Co., Pittsburgh, has been made general superintendent of the Aetna Foundry & Machine Co. Warren, O. John H. Rose, formerly in the engineering departments of the Youngstown Sheet & Tube Co., and the Republic Iron & Steel Co., Youngstown, has been made chief engineer.

A. W. Vale, who until recently has been foreman of the pattern shop of the R. V. & W. Bolt & Nut Co., Port Chester, N. Y., has accepted a position with the Bethlehem Shipbuilding Corp., Elizabeth Port, N. J.

A. Robertson, formerly works manager at the Sharon, Pa., plant of the American Steel Foundries has been transferred to Alliance, O., where he will be works manager of another plant of the same company. Mr. Robertson is succeeded by Marshall Post. M. E. First, who was works manager at Alliance, has resigned.

W. A. Toothill has been appointed sales representative for the Dayton, O., territory for the Quigley Furnace Specialties Co., New York, manufacturer of steel and alloy pots and boxes. Mr. Toothill was for some years metallurgist with the International Motors Co. at the Plainfield and New Brunswick, N. J., plants of that company.

Will Hold Fall Meeting

The fall meeting of the British Institute of Metals will be held at Barrow-in-Furness, England, Sept. 15 and 16. An extensive program of papers dealing with nonferrous metals has been prepared. The program includes an official reception by the mayor, together with visits to a number of interesting iron and steel works including the following: Messrs. Vickers, Ltd.; the Barrow Hematite Steel Works; the Barrow Paper Mills; Hodbarrow Mines; Millom & Askam Hematite Iron Works; North Lonsdale Iron & Steel Co.

Change Meeting Dates of Chicago Club

Meetings of the Chicago Foundrymen's club during September and October will be deferred one week, to the third Saturday evening of each month, instead of the second Saturday, resuming the regular schedule the second Saturday of November. The new dates will be Sept. 18 and Oct. 16.

Choose Name for Societies in Affiliation

Considerations which influenced the naming of the Federated American Engineering societies are reviewed in a bulletin recently issued by the joint conference committee of the national technical organization. According to the statement, the purpose was to secure a short title that could readily be used. The committee decided that the name of the organization should be indicative of its character, based on the fundamental resolution of the organizing conference, that it should consist of societies and not of individual members. The words "association," "confederation," "federation," and others were suggested and considered and all were rejected and finally as a compromise the word "federated" was unanimously agreed upon. As other countries are looking with interest on this movement with the probability that there will be similar organizations formed in those countries, it was felt desirable that some distinctive name should be given the organization in this country, and so the word "American" was adopted. It was thought undesirable to use as long a name as "Engineering and Allied Technical Societies," especially in view of the fact that engineering as defined in the preamble of the constitution is an all inclusive word, and it was, therefore, decided to use only the word "engineering" in the title. Hence the name "Federated American Engineering Societies."

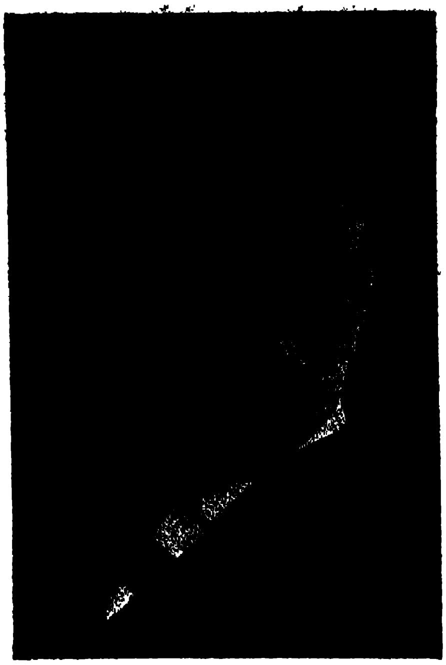
Organize Foundry

Capitalized at $400,000, the Decatur Casting Co., with headquarters at Hamilton, O., recently was organized to engage in the manufacture of gray-iron castings, which are now being produced in a plant which the company has purchased at Decatur, Ind. Officers of the company are: President, G. S. Rentschler Sr.; vice president, G. A. Rentschler Jr.; secretary and treasurer, H. A. Rentschler, and general manager, D. McDaniel.

The Service Casting Co. recently has been organized at Blanchester, O., by R. B. Huyett and Chas. N. Secrist; to specialize in small gray-iron castings. The foundry has been in operation since Feb. 1, 1920, doing contract work.

Obituary

Erastus Kies, who for many years was prominent in the malleable iron industry at Erie, Pa., died at the home of his daughter in Erie, July 18, at the age of 81. Mr. Kies first entered the malleable iron industry in the early sixties at Toledo and Canton, O., and in 1871 became associated with the Jarecki Mfg. Co., Erie. When the Erie Malleable Iron Co. was organized in 1880, Mr. Kies was appointed superintendent. He retired from active business in 1913.



ERASTUS KIES

William A. Schreiber, president, the L. Schreiber & Sons Co., Cincinnati, died recently at his home in that city.

Arthur Jerome Eddy, organizer of the American Steel Foundry Corp., National Turbine Co., the American Linseed Oil Co., and author of Eddy on *Trusts and Combinations*, recently died in Chicago.

The use of natural gas for the production of high temperatures is never satisfactory without regeneration, and most natural gas users fail to regenerate it but work with cold gas and cold air. One difficulty in making proper regenerators for natural gas is that tremendous volumes of air are required for one volume of gas; in the case of producer gas about equal volumes of gas and air are used, but for natural gas fully six volumes of air to one volume of gas must be employed.

One method of salvaging the tin from tin plate scrap consists of electrolyzing the scrap in a soda bath, from which spongy tin is thrown down on an iron cathode. The tin is scraped from the cathodes, washed, dried, melted and cast into ingots.

the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The Randall Foundry Co., Michigan City, Ind., plans to erect a foundry, 90 x 100 feet.

The Oil City Brass Works, Beaumont, Tex., is planning the erection of a new plant.

The Fisk & Jencks Foundry Co., Geneva, Ill., has purchased the buildings now occupied by H. B. Fargo.

The capital stock of the Hershey Machine & Foundry Co., Lancaster, Pa., recently was increased from $30,000 to $200,000.

Bids have been taken by the Wanner Malleable Iron Co., Hammond, Ind., for the erection of a building, 40 x 60 feet.

The Superior Steel Castings Co., Benton Harbor, Mich., is constructing a malleable iron foundry, 200 x 300 feet.

The capital stock of the Lynchburg Foundry Co., Lynchburg, Va., has been increased from $915,000 to $1,515,000.

The Fritsell Brass Foundry Co. recently purchased the plant of the International Leather & Belting Co., New London, Conn.

The Buckley Foundry Co., [illegible]ld, Mass., has completed plans for the erection [illegible] a foundry, 85 x 100 feet.

The Liberty Foundry Co, 1831 Center Line road, Detroit, shortly will start on the erection of an addition to its foundry, 75 x 150 feet.

Gaines Bros., Newport, R. I., metal wokers, have purchased a site of 15,000 square feet, on which they will erect an iron foundry.

The Pioneer Brass Works, Indianapolis, J. W. Peal, manager, will build a foundry, 150 x 181 feet.

The Atlas Foundry Co., 206 Colt street, Irvington, N. J., plans the erection of an addition to its plant, 60 x 60 feet.

The Fischer-Sweeney Bronze Co., 1301 Grand street, Hoboken, N. J., has increased its capital stock from $100,000 to $200,000.

Erection of an addition to its iron foundry, to be 55 x 100 feet, is being planned by the Davitt Foundry Co., Liberty street, Springefild, Mass.

The Pittsburgh Malleable Iron Co., 34 Small man street, Pittsburgh, has acquired a plant site, 120 x 160 feet.

The Hodes-Zink Co., Fremont, O., manufacturer of automobile castings, has acquired a site on which it plans the erection of a plant, 105 x 130 feet.

The Charles D. Hevenor Co., Buffalo, has been incorporated with a capital stock of $100,000, to manufacture machinery, castings, etc., by H. M. and J. H. Frotheringham and L. Tilden.

The New Haven Store Repair Co., New Haven, Conn., has awarded a contract for the erection of a new plant, 24 x 100 feet, with an extension, 12 x 24 feet.

Foundation work has been completed and all the electrical equipment has been purchased for the installation of an electric furnace at the plant of the Cincinnati Steel Casting Co., Cincinnati.

The Carroll Castings Co., East Chicago, Ind., has purchased a tract as a site on which to build a new plant. The company, which is capitalized at $25,000, will manufacture gray iron castings.

The Modern Foundry & Machine Co., Minneapolis, L. J. Bedard, manager, 3132 Snelling avenue, is building a foundry and machine shop, 74 x 140 feet.

The Southern Equipment Co., Laurel, Miss., capitalized at $10,000, has been chartered to manufacture foundry products, by R. J. Coffman and J. M. Calhoun.

The Richmond Hill Foundry Co., Brooklyn, N. Y., has been organized by R. J. A. Williams and J. M. O'Shea, 189 Montague street, Brooklyn, to engage in the manufacture of iron and steel castings, etc.

The buildings formerly operated by the Rhode Island Perkins Horse Shoe Co., Valley Falls, R. I., are being altered for an iron foundry for the Chelsea Iron Works Co.

The Kenosha Foundry Co., Kenosha, Wis., plans to construct a foundry, 50 x 150 feet.

The American Carbonic Machinery Co., Grand Rapids, Wis., manufacturer of ice machines, etc., plans the erection of a number of plant additions, including a pattern storage building.

The Elkhart Foundry & Machine Co., Elkhart, Ind., contemplates the erection of an addition to its plant.

The Bernert Mfg. Co., 489 Twelfth street, Milwaukee, has awarded contracts for the erection of a new foundry and machine shop, 60 x 160 feet, and 40 x 60 feet.

The Albion Foundry & Machine Co., Albion, Mich., has been incorporated with a capital stock of $100,000, by Arthur C. Hudnutt and others, to take over the foundry of the Union Steel Products Co.

The Worthington Pump & Machinery Corp. has started work on the construction of a new pattern shop at its plant in Cudahy, a suburb of Milwaukee. John D. Bird is general manager.

The P. D. Piston Ring Co., Eau Claire, Wis., is a new corporation, organized by C. M. Pratt, Edward L. Ross and Joseph C. Culver, to engage in the manufacture of piston rings, etc.

The Aluminum Manufactures, Inc., Cleveland, has purchased a 10-acre site at Marysville, Mich., on which it plans to build a plant for the manufacture of aluminum castings and drop forgings.

Fire recently damaged the plant of the Murphy Foundry Co., Beaver Falls, Pa., manufacturer of iron and steel castings. The plant will be rebuilt.

The Industrial Production Engineering Co., Dayton, O., wood and metal pattern maker, plans to increase its capital stock from $10,000 to $25,000, to finance the enlarging of its plant.

An addition is being erected to the foundry of the Buckeye Foundry & Mfg. Co., Overpeck, O., which it is expected will be ready for occupancy shortly.

A company is being organized at Benton Harbor, Mich., by O. R. and W. E. Allerton, of the Allerton Pattern Works, Benton Harbor, which will engage in the foundry business.

The Walker & Pratt Co., 33 Union street, Boston, manufacturer of boilers, stoves, etc., with a

plant at Watertown, Mass., is having plans prepared for the erection of a foundry, 200 x 230 feet.

Charles McMurphy, formerly connected with the Laconia Car Co., Laconia, N. H., with a number of associates is erecting a foundry at Concord Junction, Mass.

The Fairbanks Co., 4-10 Glenwood avenue, Binghamton, N. Y., manufacturer of iron and brass valves and other metal products, has had plans prepared for rebuilding its foundry, 44 x 100 feet.

Capitalized at $50,000, the Buffalo Brass Casting Corp., Buffalo, recently was incorporated to manufacture brass, bronze and other metal castings, by J. and G. Popp and C. Rosenberger.

Plans are being made by the Virginia Iron, Coal & Coke Co., Toms Creek, Va., to rebuild its foundry, machine shop and carpenter shop, which recently was damaged by fire.

Plans have been prepared for the erection of a foundry for the John J. Riley Co., Brooklyn, N. Y., which operates an iron and brass foundry on Van Brunt street.

The capital stock of the Rockford Union Foundry Co., 1120 River street, Rockford, Ill., recently was increased from $25,000 to $40,000. J. P. Lundell is president of the company.

The Akron Gear & Engineering Co., Akron, O., has under consideration the erection of a new plant. The company in addition to manufacturing gears, makes rubber machinery, tire cores and molds. L. A. Palmer is president.

The Hays Mfg. Co., Twelfth and Erie streets, Erie, Pa., manufacturer of brass and bronze products, has broken ground for the erection of an addition to its plant, 55 x 112 feet. William H. Foster is president of the company.

The Phoenix Foundry Co., Dallas City, Ill., will open a foundry in the building formerly occupied by the Northwestern Stamping Co., 800 Osborne street, Burlington, Iowa. Brass and aluminum ware will be cast.

The Wildman Mfg. Co., Norristown, Pa., manufacturer of machinery and parts, contemplates the erection of a new foundry and plant addition. Lockwood, Greene & Co., 101 Park avenue, New York, are architects.

Capitalized at $50,000, the Forest City Foundry Co., Rockford, Ill., recently was incorporated to manufacture castings, by Frank Johnson, Charles Johnson, Charles Leise, Otto Anderson, Carl Knutson and others.

The Newark, N. J. plant of the Crocker-Wheeler Co., Ampere, N. J., which has been used for the production of castings, has been placed on the market. The foundry comprises about 20,000 square feet of floor space.

The Gerlinger Steel Casting Co. and the Gerlinger Electric Steel Foundry Co., West Allis, Milwaukee, have been consolidated under the name of the Gerlinger Electric Steel Casting Co. with a capital stock of $500,000. Walter Gerlinger is secretary.

The Nelson Pulley Co., Milwaukee, recently was incorporated with a capital stock of $25,000, to manufacture transmission appliances, and to operate a foundry and machine shop, pattern shop, etc. The incorporators are Joseph R. Tierney, H. J. Ross and Frank J. Jennings.

M. G. Tennant, former manager of the Olympic Steel Works, Seattle, recently purchased the plant of the Malleable Steel & Iron Co., at 1163 Minneapolis street, Tacoma, Washington, and improvements are now being made to the plant, which will be operated under the name of the Tennant Steel Casting Co.

The Waterbury-Farrell Foundry & Machine Co., Waterbury, Conn., has increased its capital stock from $440,000 to $2,500,000. The company manufactures machinery and castings, including hydraulic equipment, and recently established a plant at Buffalo. The company also started the construction of an addition to its plant at Waterbury, to be 43 x 180 feet.

By moving its offices into an adjoining building, the Plymouth Foundry & Machine Co., Plymouth, Wis., has gained considerable space which is being turned over to toolroom and stockroom purposes, for which new equipment has been purchased.

The Keeley Stove Co., Columbia, Pa., has had revised plans prepared for the erection of a new plant, 25 x 30 feet.

The Standard Malleable Co., Zanesville, O., has been incorporated with a capital stock of $100,000, to take over the plant of the Weldig Foundry Co. The company will specialize in the manufacture of malleable castings for radiators and will also make gray iron castings. The officers are: President, Eli A. Palmer; vice president, W. M. Bateman, and secretary-treasurer, A. L. Rea.

Capitalization of the United Machine & Mfg. Co., Canton, O., recently was increased to provide for the expansion to the company's present plant. The additional facilities will include a gray iron and semisteel foundry, which will have a capacity of from 25 to 50 tons daily. Additional machine tools and foundry equipment will be purchased within the next 90 days, according to E. E. Griffith, president of the company.

The Non-Ferro Foundry & Pattern Co., Toledo, O., has acquired the plant of the M. De Mers Blacksmith, Tool & Machine Co., and will operate a foundry and pattern shop. The company has increased its capital stock from $10,000 to $25,000. P. A. Gaynor is manager.

The Van Brunt Mfg. Co., Horicon, Wis., manufacturer of drills, seeders and agricultural implements, plans to increase the capacity of its plant by the erection of a foundry addition, 80 x 200 feet; a forge shop addition, 50 x 90 feet; a steel storage building, 40 x 150 feet and a dry kiln addition, 30 x 90 feet. It also plans to erect a steam generating plant addition, 50 x 60 feet. Fred H. Claussen is president and general manager.

New Trade Publications

TRUCKS.—The Available Truck Co., Chicago, has published a folder in which the specifications, etc., of trucks which it manufactures are given. The leaflet also contains line drawings of the truck.

REFRIGERATING PLANT.—Refrigerating plants designed for household service, are described and illustrated in a booklet recently issued by the Norwalk Iron Works Co., South Norwalk, Conn.

CHAIN BLOCKS AND TROLLEYS.—The Yale & Towne Mfg. Co., Stamford, Conn., has issued an illustrated booklet in which the use of chain blocks and trolleys in machine shops, is shown by a number of illustrations.

ELECTRODES.—The Acheson Graphite Co., Niagara Falls, N. Y., is circulating a leaflet in which attention is called to electrodes which it manufactures. The bulletin is a reprint of an advertisement which was published in a recent issue of *Chemical & Metallurgical Engineering*.

FOUNDRY EQUIPMENT.—Molding machines, both hand and air power, jolt stripping plate machines, core machines, lifting devices, piston machines, pouring devices, and other foundry equipment are described and illustrated in a 4-page folder being circulated by the Arcade Mfg. Co., Freeport, Ill.

DOOR OPERATOR.—The Loeb-Walters Co., Cleveland, is circulating a 4-page folder in which it describes and illustrates an automatic door operator for use in factories, warehouses, garages, etc., where opening and closing of large doors manually has been difficult. The device described is operated by air. Details are given.

ELEVATOR CONTROLLERS.—The Cutler-Hammer Mfg. Co., Milwaukee, has published a 24-page illustrated booklet in which controllers for electric elevators are described and illustrated. The booklet points out the salient features of the controllers and gives full details, as to design, construction and operation.

BELT JOINING.—The Crescent Belt Fastener Co., 381 Fourth avenue, New York, recently has issued a booklet describing the application of its device. This booklet, entitled *Modern, Scientific Methods of Belt Joining*, contains practical information on up-keep and care to assure the best service from power belts.

SAND BLAST APPARATUS.—The injector sand blast apparatus is described and illustrated in a booklet being circulated by J. M. Betton, New York. This apparatus is adaptable for use with high or low pressure and may be used for cleaning castings of all kinds, metals for machining, removing paint, rust, etc. The booklet gives details as to construction and operation.

VENTILATING FANS.—An illustrated booklet has been issued by the Buffalo Forge Co., Buffalo, in which conoidal fans for use in ordinary heating and ventilating practice are described and illustrated. This fan is of the multiblade type, having blades of single curvature conforming to the surface of the cone. Full descriptions of the various parts of the fan are given, and the booklet also contains tables of performances which should be of aid to engineers and architects in making fan selections.

PNEUMATIC TOOLS.—A 124-page illustrated catalog is being circulated by the Keller Pneumatic Tool Co., Grand Haven, Mich., in which pneumatic riveting, chipping, calking, flue-beading and scaling hammers; pneumatic dolly bars, holders-on, jam riveters, rivet busters and sand rammers, as well as pneumatic valveless and corliss valve piston drills, wood boring machines, grinders and various accessories and parts of pneumatic tools are described and illustrated. The booklet gives specifications and other data.

PIPE WELDING.—The Metal & Thermit Corp., New York, has issued and will distribute on request the third edition of its pipe welding pamphlet No. 16. The new pamphlet describes and illustrates in detail how thermit pipe welds are made and contains reports on tensile strength and vibration tests of pipe welds conducted by Stevens Institute. One of the features of the new pamphlet not published in former editions is a chart showing the comparative cost of a welded pipe with the cost of installing compression flanges with bolts and gaskets and of installing elbows with flanged connections. The new edition also contains an account of a 10-year pipe test at West Albany, N. Y., during which 700 feet of 4-inch extra heavy welded pipe, which connected a power house of the New York Central Lines with a boiler house, was constantly subjected to a hydraulic pressure of 1500 lbs. to the square inch.

ROTARY POSITIVE BLOWERS.—A second edition of its catalog of rotary positive blowers has just been issued by the P. H. & F. M. Roots Co., Connersville, Ind., 48 pages printed on fine stock, covered with heavy embossed paper. As in the first edition space formerly given to engravings of blower installations has been used for engineering data. These data are full and designed to give users of blowers full information when ordering equipment to match their needs. Clear explanation is made of the operating principle of the blower, with diagrams and the catalog then passes to descriptions of the various types of blowers and their parts, as well as the materials of which they are constructed. Halftones of the several types are presented. Full instructions, illustrated by a table of sizes, are given for selection of a foundry blower, for those used in connection with oil and gas furnaces and steel converters. Full explanation is made of couplings and valves. Graphs make it easy to determine air velocities, pipe friction and flow through orifice.

The FOUNDRY

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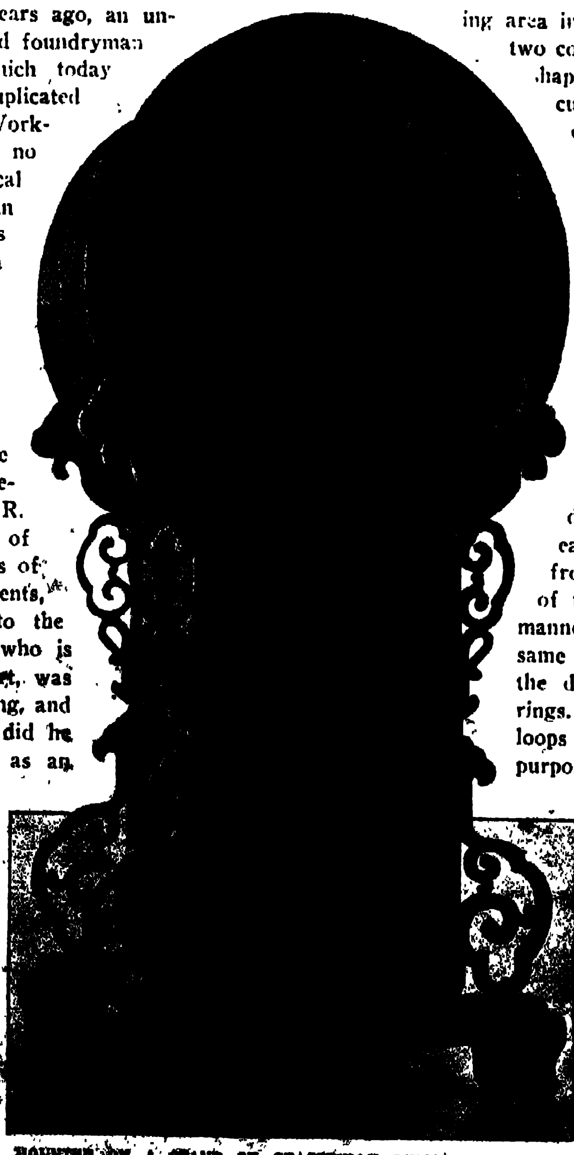
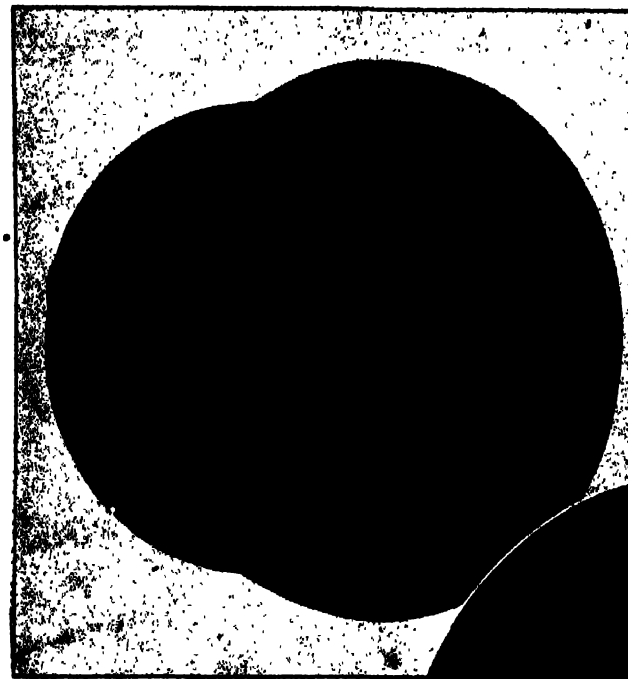
Ancient Bronze Baffles Founders

Chinese War Drum Cast at the Beginning of the Christian Era Is a Molding Enigma—Modern Cylinder Shops Would Have Trouble Duplicating This Relic

ALMOST two thousand years ago, an unknown Chinese artist and foundryman produced a casting which today probably could not be duplicated nor even imitated with success. Working with primitive instruments, no doubt with the crudest of mechanical devices and melting his metal in an open-flame, charcoal furnace, this ancient foundryman produced a work which is as inscrutable as the character of the millions who throng the Celestial Empire. That feeling of pleasure which appreciates symmetry in all things, cannot but react to the beauty of this casting which forms one of the most prized exhibits at the Cleveland Museum of Art. Worcester R. Warner, scientist, engineer and one of the world's foremost manufacturers of astronomical and precision instruments, was the donor of the casting to the Cleveland museum. Mr. Warner, who is himself an authority on Chinese art, was attracted by the beauty of the casting, and not until it was in his possession did he appreciate the value of [illegible] piece as an example of the work of [illegible]ent foundrymen. The casting is a Chinese war drum, of a peculiar form, which from a comparison with one or two other drums in this country and in China, seems to have been characteristic of a certain district in the southeastern portion of the country. The drum is circular in form, with a flat top, which extends beyond the sides as may be noted from the illustrations. The sides are curved and shaped in graceful contour, with a convex or bulging area immediately beneath the top, and with two concave portions meeting in a sharp V-shaped ridge extending around the circumference at about a third of the distance from the bottom. The lower edge is beaded to a thickness about twice as great as the shell or sides. The top is decorated by a series of 18 concentric circles, repeating at irregular intervals designs composed of small characters. These figures are in relief and stand out strongly. The center is a circular boss with radiating rays in relief. The boss doubtless was the point where the drum was struck in sounding. Around the outer circumference, spaced at equal distance are conventionalized frogs, each alternate one bearing a smaller frog upon its back. The outer surface of the shell is ornamented in a similar manner with parallel rings formed of the same designs used in the head, and with the double lines separating the different rings. On opposite sides two pairs of loops are attached, apparently for the purpose of forming supports, by which cords were attached to swing the drum with the flat surface upward. J. Arthur MacLean, curator of Oriental art at the museum, ascribes this casting to the people of the Szechman province in southeastern China, and states that various undisputed evidences place its origin at some time in the Han dynasty, which embraced the years from 202 B. C. to 220 A. D. A similar but smaller drum, described in a work on Chinese art published by the Victoria

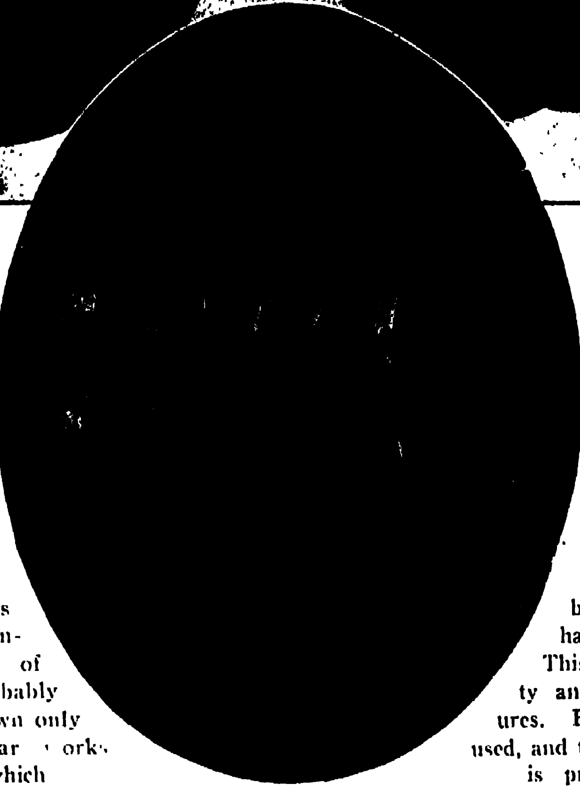


MOUNTED ON A STAND OF GRACEFULLY DESIGNED CARVED WOOD, THE CASTING IS THE CENTER OF ATTRACTION IN THE ORIENTAL SECTION



THE INTERIOR STILL BEARS TRACES OF ANCIENT MOLDING SAND

TWO DIAMETRICALLY OPPOSITE PARTING LINES ARE APPARENT IN THE SIDES



CLOSEUP OF ONE OF THE TWO PAIRS OF LOOPS - FULL SIZE

and Albert Museum, bears the inscription beginning: "Made on the fifteenth day of the eighth month of the fourth year (A. D. 199) of the period of Chien An." The same description states that the war drums were known as Chu-ko Ku, or Chu-ko's drums after the famous Chinese general, Chu-Ko Liang, who invaded the Shan country early in the third century, one of the drums still being preserved in his own ancestral temple in the province of Szechuan. The history, and probably early service of the casting is known only through comparison with similar works which have been inscribed, or which through recorded data may be traced back to the ancient era when the bronze from which it was made was melted and cast. The physical aspects of the casting, that at once impress every foundryman present even more of an interesting mystery than its origin and history. The size, and extremely light section, coupled with the relief work in ornamentation and the attached devices on the top and sides, make the casting one which would be exceedingly difficult if not impossible to duplicate.

The flat drum-heat measures 2 feet 10¾ inches in diameter; the height, measured from the bottom, or open end to the edge is 1 foot, 8¾ inches; the diameter at the lower edge is 2 feet, 9¼ inches; and the circumference around the depression which forms the smallest section, immediately beneath the loops, is 7 feet, 10 inches. It thus may be seen that the drum is large compared with the average present day art bronze, such as vases, urns and hollow-ware vessels of a similar nature. Yet, the average thickness of the sides and head is about 3/16 inch, and is uniform throughout as to prompt the greatest admiration from modern foundrymen. It weighs only 128 pounds.

To the artist and antiquarian familiar with ancient examples of oriental workmanship, the beauty and precision of the casting is readily apparent, and in no way surprising. The signs by which molders may analyze the way in which a casting was formed in the sand, are contradictory, and no positive evidences apparently are available to prove what combination of operations was employed.

It may be established that the drum was poured with the flat head uppermost. The marks of 30 sprues, plainly are evident, spaced at equal distances between the frogs, and directly over the sides of the drum. It is probable that a concentric row of risers was placed nearer the center or that the center boss may have been carried up through the cope. Some irregularities at intervals nearer the center seem to support this assumption. These latter are also concentric with the drum-head boss. The lost wax process may have been used in molding the drum. This theory would explain the regularity and precision of the decorative figures. However, if this method had been used, and the entire design made in the wax it is probable that the small decorative motifs would have appeared depressed in the surface of the casting instead of standing out in relief as they do.

It is not beyond belief that a cylindrical core was swept about a spindle and molded to the contour of the drum. The core then may have been coated with wax to the desired thickness and a drag, split vertically, set around it. This after ramming probably was swept level with the top of the core. Then a thin flat pattern of the top, carrying the rays emanating from the spindle, was set on the cope, rammed and the sprues made. The pattern was lifted with the cope. The cope then was turned over and the pattern drawn. The wax over the sides of the core was melted and allowed to run out. The two halves of the drag were drawn back horizontally on the plate, lifted to one side, and probably again set up with a spindle or rotating shaft vertically located at the center. A marker or templet rotating on this shaft prob-

ably was used to scratch the horizontal rings which space off the different designs on the sides of the drum. The halves then doubtless were placed with the inner surface upward, and the different designs, carried on some sort of block were stamped at intervals as they appear on the surface.

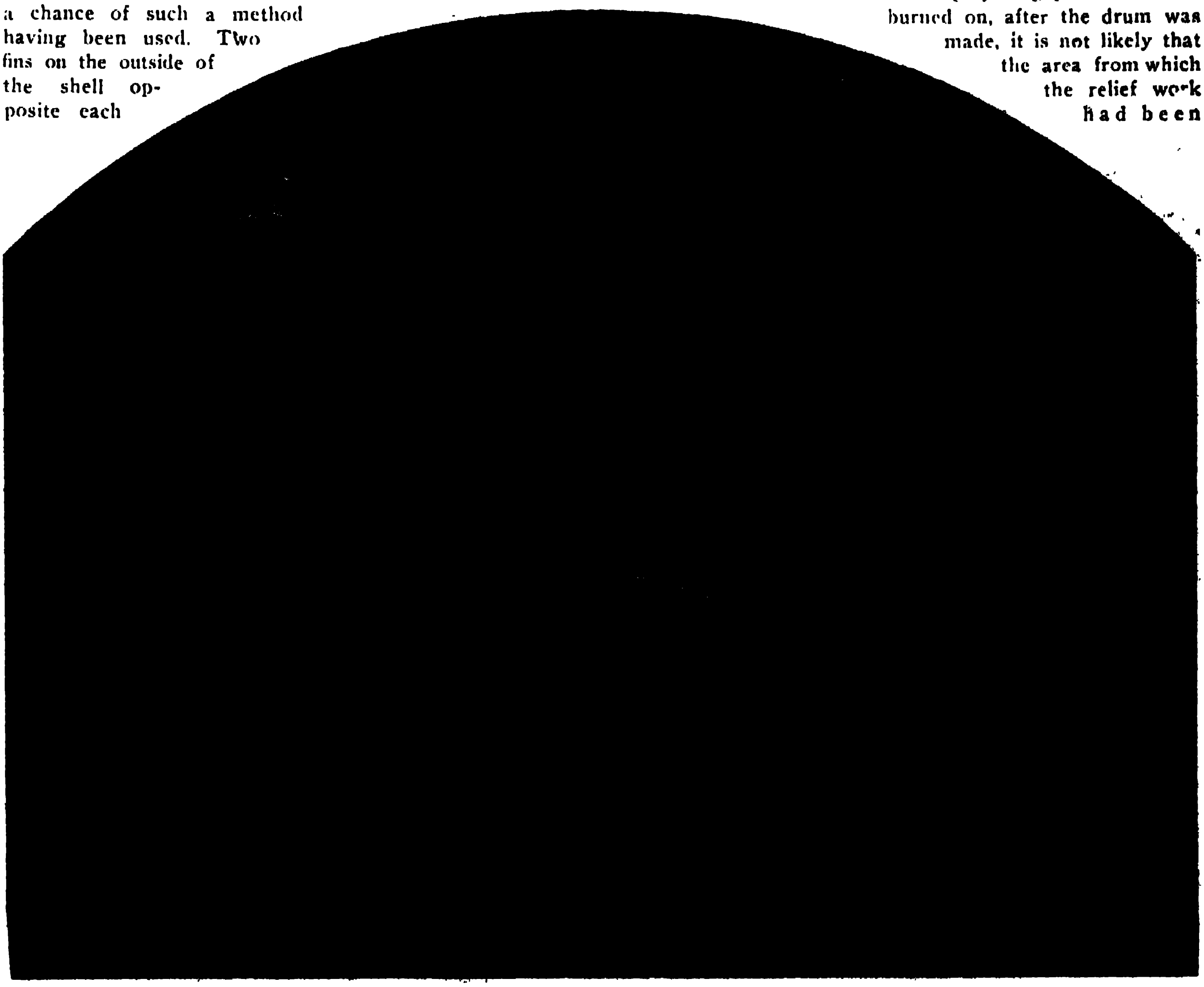
The designs upon the top probably were made in a similar manner, the concentric rings being scratched in the surface and the small characters stamped with the repeated pressure within the rings.

This theory of the method of molding has many evidences to support it, but nevertheless is weakened by some characteristics and practical considerations that seem hard to answer. The lost wax process alone could supply the exceedingly thin section of the sides, as it is almost unbelievable that the two halves of the drag could have been molded against the core, after a parting material had been applied, then drawn away, finished and put back with a spacer between the two halves. The even thickness, which from close observation does not vary by 1/32 inch over the entire circumference, precludes a chance of such a method having been used. Two fins on the outside of the shell opposite each other in the sides, prove beyond question that the two halves *were* drawn back and again replaced.

That the horizontal rings, and those which separate the different circles of figures on the top, were scratched into the surface is practically proved by close examination. Traces of slight irregularities, and the variation in the weight and thickness of the lines point to this assumption as correct.

That the small decorative figures were stamped in, is shown by their irregularity of outline and the uneven spacing which might be expected were they applied in this manner. Further, the patterns often overlie the lines, and tend to prove that they were stamped in the mold after the lines had been made. Granting this theory, it is difficult to conceive of the patience which would apply these small stamps to the surface a sufficient number of times to make the thousands of impressions. On the top of the drum alone there are probably 5000 distinct marks which must have been made in this manner, and the sides doubtless carry many more. It would be interesting to know exactly how the molder maintained a surface which would take the impression of his stamping tool, or type as it was in reality, and whether after the design had been finished, the mold was baked or dried. Some traces of the molding sand remain within the drum, under a surface of soil or dust of more recent origin. The molding sand is impalpably fine. In fact it seems to the touch to be as light as modern parting dust. The color indicates a clay texture, although the sand does not leave a deposit of this material when rubbed between the fingers.

The loops on the sides, and the frogs which ornament the top have the appearance of having been cast on. In this event, they probably were contained in small cores which were set into the center of the two drag sides, and in the cope after it was finished. This theory is sustained by the smoothed areas about each of the devices mentioned, which might have been made by the molder smoothing over a joint which was made when the core was set into the surface of the mold. If the projecting pieces had been burned on, after the drum was made, it is not likely that the area from which the relief work had been



THE DRUM HEAD AND THE SIDES ARE COVERED WITH INTRICATE DESIGNS—NOTE THE UNEVEN SPACING OF SIMILAR CHARACTERS TO GIVE VARIETY

erased would have been so large. The closeup of the loop, shown on page 668, also indicates that there were lines which might have been made when the metal sought to follow the joint made by the recessed core. In further proof of the cast-in explanation, some traces of the same molding sand found inside the drum has been noted clinging to the under side of the frogs. However, the loops at the sides are clean, and show evidences of having been used to support the weight of the drum.

As was stated, the method of molding is open to dispute. Several foundrymen of wide experience who have examined the relic state that to take the two halves of the mold apart and return them again to their places surrounding the core would be beyond possibility with ancient rigging. They point out that to do this would require exact machining of the joints, where the two halves came together, and also of the supporting plate. Any slight tilting of either half from the exact perpendicular would have caused the metal of the sides to have been pinched off or to have been thicker than desired. It indeed is difficult to conceive how the two parts were brought together to give an exact thickness throughout the entire circumference. Yet the Chinese invented the first astronomical instruments, several hundred years before they were conceived in European minds, and the perfection of their execution made some of them serviceable from the early thirteenth century until they were dismantled and stolen by the Germans during the Boxer uprising.

A few observations by John C. Ferguson, published by the Smithsonian institution are apropos. He states:

"In casting vessels, the ancients (Chinese) used wax for their models or patterns, and the lines were thin like hairs—even, regular and distinct. The characters were rounding like the surface of inverted tiles. They were not deep or bold and both large and small characters had the same depth. They were clear and distinct, without any blurs. Such castings of carefully chosen bronze were excellent. They had three characteristics: First, they had no marks of sand granules; second, the workmanship was wonderful: and third, there was no sparing of labor. They were not made overnight. * * *

"The sound given out by ancient bronzes is clear, while that of modern pieces is confused and noisy."

In a book by Charles Bushnell, published by Victoria and Albert Museum, the composition of bronzes during the Chou dynasty (B. C. 1122 to 249) is given from a translation of the K'ao Kung Chi, a contemporary work on the industries of the period. It is stated that during that most remote period a succession of six alloys was used, in which the proportion of tin gradually was increased from one to five, to one to one with copper. The lesser metals in the alloys are not given, as they probably existed as unknown impurities in the two main constituents. The alloy with five parts of copper to one of tin was used in the fabrication of bells, caldrons and gongs; sacrificial vessels and utensils and other cast hollow ware.

A careful analysis of the metal in the war drum at the Cleveland museum was made for THE FOUNDRY, through the courtesy of Mr. MacLean of the museum and the donor of the casting, Worcester R. Warner. Filings were taken at points which did not mar the surface. This analysis showed the following composition:

	Per cent
Copper	74.30
Lead	16.80
Iron	.14
Aluminum	.01
Antimony	.08
Zinc	trace
Tin	8.57

The high lead content is remarkable. The alloy is practically a bearing metal with 8 per cent tin and 20 per cent lead added. Although the drum antidates all knowledge of aluminum, the metal is present and doubtless had its influence upon the properties.

It may be noted from the accompanying illustrations that the drum has three breaks in the surface of the sides. None of these is an imperfection in the casting, and each bears evidence of having been caused by rough handling at some time during the centuries which have dragged by since the casting was poured. The long break, which in the view of the interior is shown to have been mended, occurred before the casting reached America, as is evidenced by the process employed in its repair. Small holes were drilled opposite each other on the two sides of the break. These were carried only part way through the shell. Sharp staples made of tin, or some other white metal of similar texture and hardness, were applied with the sharp ends set into the drilled recesses. These staples then were tapped down flush with the shell, and tended to hold the break together. It is said that a similar mode of repair is employed in mending broken pottery which is received from China.

The Shea Bronze Casting Co. 232 Fifth street, Bridgeport, Conn., is completing a new foundry and desires to purchase a small core oven, 12 x 18 and 11 x 14 iron or steel flasks, a tumbling barrel, sprue cutter, motor driven grinder, small tools and supplies.

Ladle Additions for Softening Iron

Question.—In pouring off big heats of hard iron for grates, brake shoes, bearing ribs, etc., the iron from the latter part of the heat comes down dull. We have been using the same amount of coke for the hard iron as for machinery iron mixtures. Could we use any chemical in the ladle to increase the temperature of the iron and soften it?

Answer.—We would not recommend that you put anything in the ladle to increase the temperature of the iron. High enough heat should be obtained by proper melting and we recommend that you use more coke between the charges. This will give you hotter iron. Hard iron with its low silicon and high sulphur must be melted at a higher temperature than machinery iron.

Should you desire to soften the iron by ladle additions, it could be done by adding a small amount of 50 per cent ferrosilicon and four to six pounds of 80 per cent ferromanganese to a ton of metal. These alloys should be thrown into the ladle while the stream of iron is running into it from the cupola. The amount of ferrosilicon to use will depend upon the amount of silicon in the iron, but it is impractical to add much silicon in this way. A large amount cools the iron and as ferrosilicon is lighter than iron it has a tendency to float to the top and not melt. We believe a better way to soften the iron would be to use a small amount of ferrosilicon on the charge in the cupola. The amount to add could be judged from the percentage of silicon in the mixture and then figuring the increase to be gained by the ferrosilicon addition. This would be done as follows:

Weight of metal Pounds		Per cent Silicon	Total
1000	x	2.00	2000
20	x	15.00	300
1020 divided into			2300
			2.25
Less loss in cupola			.25
Silicon in finished metal			2.00%

Requests Literature on Foundry Equipment

The Kokomo Malleable Iron Co., Kokomo, Ind., through W. C. McCoy, states that it is planning to enlarge its plants for the production of malleable castings, and that, although it is fully covered on most of its machinery needs, the company would be pleased to receive literature on a general line of foundry equipment. The proposed plant will be of the latest type construction, and it is expected to be ready for occupancy by the end of the year.

Cupola Practice Is Not Consistent

The Seemingly Inevitable Coke Shortage May Prove a Blessing in Disguise if It Forces Foundry Owners to Cut Down Their Coke Ratio

BY PAT DWYER

IT IS common knowledge among those engaged in the iron and steel industry that the coke production in the United States for 1920 will fall behind that for 1919 by probably 25 per cent. The production for 1919 showed a decrease of 11,651,000 tons from that of 1918 or from 56,472,000 tons to 44,821,000 tons, and conditions in general were more favorable in 1919 than they have been so far this year.

A discussion of the reasons for this shortage can be of no practical value alone inasmuch as we are confronted by a condition and not a theory and all the discussion in the world would not increase the present years production of coke. The only value such a discussion can have at this time is to help foundrymen realize that there actually *IS* a shortage of coke and that the shortage will be more acute as the year advances. Many, of course are aware of the serious situation, but it is doubtful if they are doing all that they can to conserve the fuel supply or taking any steps whereby their cupolas may be operated at a better coke to iron ratio. While it is true that no foundryman wastes coke wilfully or knowingly, still no one familiar with cupola practice will deny there is considerably more coke used than is necessary for the operation of the cupola.

Disturbed conditions in the iron and steel and railroad industry during the past year have been the principal underlying reasons for the low coke output this year. Considering the vast volume scope of the iron and steel business it is only natural that cancellation of war contracts, readjustments of prices and new credit arrangements, should first be felt at the source or fountain head, the blast furnace. The number of stacks out of blast materially affected the operations of the coke oven plants since the two are so closely linked together that what affects one is reflected in the other.

Exposure Effects Coke

A blast furnace, to be operated efficiently and on a paying basis, must be kept supplied with an adequate amount of coke, limestone and iron ore. The ore and limestone are stocked in huge piles near the furnace so that there may be no interruption in its operation. Besides the necessity for keeping a generous supply of material on hand, the blast furnaces situated in the northern parts of the United States and depending for the greater bulk of their ore supply on the deposits at the head of the Great Lakes, are forced to stock a sufficient supply during the open season to tide them over the period when lake navigation is suspended.

Exposure to the weather has no adverse effect on iron ore or limestone; it may be exposed for years and still be as good as when first dropped on the pile from the bucket. After exposure to the rain followed by a severe frost, it sometimes is necessary to employ dynamite to loosen it up for loading into the skips, but that is only a minor detail.

Coke is different. It should be handled while it is fresh. It cannot be stocked like ore or limestone because the weather *does* exert a decided deleterious influence on it, and further, it breaks up into smaller sizes each time it is handled. Coke drawn from the ovens is practically dry and hard and consists of lumps of fairly uniform size. However, when left exposed to the weather it absorbs moisture which not only promotes disintegration but also lowers its heating efficiency. A much larger quantity must be used to melt a given amount of metal owing to so much of the heat being expended in expelling the water from the coke itself. Even the most favorable

CONTRAST THE PRIMITIVE TYPE OF CUPOLA SHOWN ON THE LEFT OF THE ILLUSTRATION WITH THAT SHOWN ON THE RIGHT—IN THE FORMER THE SHELL IS MADE UP OF A NUMBER OF CAST-IRON STAVES BOUND TOGETHER WITH WROUGHT-IRON BANDS—THE MATERIAL FOR THE CHARGE IS CARRIED UP THE LADDER BY HAND AND DUMPED DIRECTLY INTO THE OPEN TOP OF THE STACK—IN THE LATTER THE MATERIAL IS CHARGED WITH A SKIP LIKE A BLAST FURNACE

TABLE I

Representative Reports on Cupolas 24 to 28 Inches Inside Diameter

Diameter in inches	Total Charge pounds	Time hours	Bed Coke pounds	Iron Charge pounds 1st charge	Iron Charge pounds others	Coke Charge pounds	Class of work	Blast oz.
24	14000	5	500	1480	980	50	converter	..
24	4500	1½	395	400	400	35	jobbing	..
27	5030	1½	260	1000	500	40	jobbing	..
28	4500	1	350	500	500	120	light	.
28	2000	½	350	1250	750	40	jobbing	
28	2000	½	350	1250		150	jobbing	4
30	12000	2½	600	800	800	75	agricultural	8
30	4200	1	525	1000	800	80	light	
30	.		450	500		60		8
30	6600	3¼	425	600	..	80	light	5
30	10000	2½	550	500		50	general machinery	
32	20000	3	1000	1000	1000	125	auto	8
32	8000	2	500	1000	1000	85	jobbing	8
32	12000	2	600	1000	.	100-75-100	general	
32	9000	4	425	6000	.	80	light	5
32	15000	1½	450	1000		100	gen'l machining	12
32	10000	2	500	550		50	gen'l machining	10
34	1200	1¼	800	2500	2000	150	jobbing	8
34	800	1½	500	1200	1200	150	jobbing	12
36	42000	6	450	600	600	80	light	12
36	18000	1	800	1000	1000	160	stoves	16
36	12000	4	900	1000		100	pipe & fittings	14
36	18000	1½	625	2000		175	machine tools	9
36	16000	1½	900	1500	.	150	textile machinery	.
36	5500	¾	460	1000		80	light machinery	.
36	12000	1½	600	2000		200	light machinery	10
36	10000	1	500	1000		100	machine tools	10
36	20000	2½	700	1000		100	gen'l machining	12
36	10000	2	800	1200		100	jobbing	9
36	14000	1¾	650	1600		65	jobbing	8
36	8500	1¼	600	1000		100	light machining	7
36	10000	1¼	500	1000		85	jobbing	8
36	42000	6	450	600		80	light work	12
36	21000	2½	1200	2000		200	jobbing	14
36	12000	1½	950	1500	1000	125	machine tools	.
36	6500	1	1025	4000	1500	250	machine tools	12
36	12000	1¼	650	800		80	machine tools	10
36	6000	1	400	1500			gen'l machining	12
36	7000	½	600	1000	2500	120	stove plate	13
36	16000	2½	650	1500	1000	120 100	jobbing	10
36	7000	1	600	1200	1100	100	jobbing	14
36	15000	1	600	1000		100	jobbing	.
36	10000	1½	720	1500	1000	120	jobbing	..
36	18000	2	800	1000		160	stoves	16
36	10000	2	750	1000	.	110	light	12
36	9000	1¼	750	1200	2000	125	agricultural	10
36	12000	1½		1500			.	.
36	12000	1½	1500	2000		150	light	16
36	19000	2	750	1500	1000	115	furnaces	.
38	7000	1¼	200	1500	1000	100	gen'l machine	10
38	12000	1½	850	1000		100	stoves	10
40	14000	3	1500	2000	.	340	soil pipe	8
40	36000	4½	900	2000		350	light work	8
40	10000	1¼	720	1600		170	gen'l jobbing	11
40	10000	1	1500	3500	5000	600 300	gen'l jobbing	7
40	10000	1	1000	1000		110	jobbing	11
40	68000	1	1000	2000	1500	200	jobbing	8
40	100000	9½	900	1125		180	converter	8
42	12000	1	950	2400	1200	180	gen'l jobbing	16
42	8000	1	1200	2500		210	light work	8
42	18000	2½	700	1000		100	light work	..
42	8000	1	1100	2000		170	gen'l jobbing	14
42	19000	2	1320	2000		220	gen'l jobbing	11
42	18000	1½	800	2000	1800	200	gen'l jobbing	10
42	32000	2¼	1000	1000	.	100	gen'l jobbing	
42	20000	2	1100	2000	.	200	gen'l jobbing	.
42	12000	1¼	600	2500	...	300	machine tools	14
42	56000	9	900	1100	...	250	agricultural	10
42	42000	2½	1350	2000	..	216	gen'l machining	12
42	20000	3½	1100	2000	...	240	gen'l machining	14
42	40000	4	400	1500	..	250	gen'l machining	14
42	14000	2	1260	2000		260	oil engines	..
42	14000	1	800	2400	1200	125	jobbing	14
42	15000	2	720	1300	650	140	jobbing	10
42	12000	1¼	800	2000	...	160	light	12
42	10000	1	800	1000	...	85	jobbing	12
42	10000	1	700	2000		..	jobbing	14
42	36000	2½	600	3000	1500	300	jobbing	12
42	50000	7	1800	1500	...	150	converter steel	..
44	23000	2	950	1500	....	180	air compressors	14
44	32000	2¼	1350	2000	.	210	light work	16
44	15000	1½	1200	2000	...	220	light work	18
44	13000	1½	1000	3000	1500	150	light work	10
44	18000	1½	1200	1500	....	130	gen'l machining	.
44	24000	1¾	825	2500	....	200	light	9
44	25000	2	1100	2000	1500	150	heavy mach'n'g	16
44	25000	1½	600	2000	..	200	jobbing	8
44	20000	1¾	1200	2000	1700	160	stoves	12
44	36000	2½	1500	2000	...	200	light	16
44	32000	2	1500	2000	....	200	light	13
44	24000	2	1000	2100	...	300	light	10
44	12000	1½	900	1000	....	90	light	16
46	38000	2½	850	2500	....	120	light machinery	..
46	30000	1¾	1000	1200	...	150	machine tools	10
48	40000	2½	1600	3000	...	300	jobbing	12
48	50000	4	1500	2000	...	300	auto engines	17
48	60000	4	1800	3000	2000	300	jobbing	12
48	20000	2½	1500	2000	....	220	machine tools	..
48	48000	3	1900	3000	...	315–280	light	..
48	40300	2	1800	2000	....	200-200-	jobbing	13
48	20000	1¼	1200	2000	..	last 200 (150)	light	..
48	18000	1½	1900	4000	2000	200	jobbing	10
48	7500	1	850	2000	1500	200	jobbing	8
48	48000	3½	1500	3000	1700	230	heavy	12
48	30000	2	2400	6000	3000	400	heavy	13
48	30000	1½	1100	1000	....	130	light	11
48	40000	3	1800	3000	2500	500	heavy mach'y	11
48	58000	5	2000	4000	...	250	gen'l jobbing	15
48	22000	1½	1700	2100	.	350	light work	11
48	40000	2	2000	2000	..	200	light work	14
48	12000	1½	1000	2000	....	300	stove plate	14
48	20000	2	800	1000	..	100	pumps	..
48	20000	1	1400	2000	..	250	agricultural	12
48	30000	1¾	1200	2000	...	220	gen'l machining	12
48	15000	1½	1200	2000	....	240	gen'l machining	10
48	14000	1	1350	2200	..	225	engines	10
48	50000	2½	1500	2000	.	300	railroad castings	.
48	20000	1½	1200	2500	2000	150	gen'l machining	10
48	30000	2¼	1200	2500	2000	250	pumps	14
48	30000	1¾	1400	2000	..	200	jobbing	16
48	96000	5	1800	1500	...	175	converter steel	15
48	75000	1	800	1500	..	160	gen'l jobbing	
48	18000	1¾	1350	3000	..	300	gen'l jobbing	12
48	24000	1¼	1600	3500	2000	200	light work	14
48	40000	2½	1700	2000	.	200	agricultural	8
48	12000	1	1200	2000	..	200	heavy mach'n'g	16
52	16000	1	1700	5000	..	650	jobbing	16
52	88000	4	2600	4000	...	400	valves	14
52	50000	2½	1600	3500		400	soil pipe	8
52	21000	1½	1500	3000		300	jobbing	.
53	15000	1½	550	1000	.	102	pumps	14
54	36000	3½	1200	2800	.	200	machinery	14
54	50000	2½	2400	2000	...	250	machinery	13
54	20000	1½	1250	2300		230	light work	14
54	40000	2	1750	3000	3000	310	light work	14
54	60000	2½	2000	4000		420	gen'l machining	..
54	50000	2½	2400	2000		250	gen'l machining	12
54	34000	2	1400	3000		400	furnaces	..
54	45000	2	1200	5500	5000	580	light work	16
54	50000	2½	1700	3000	..	450	sanitary ware	12
54	46000	3½	1550	3000		300	gen'l machining	10
54	90000	3½	1500	1500		150	mining mach'y	6
54	60000	3	1700	2000	.	250	agricultural	8
54	36000	2	1600	4000	.	400 300	machining	14
54	21000	1½	2000	3000		350	gen'l machining	14
54	30000	1½	1800	3000		200	light	.
54	29000	1¾	2000	2400		230	jobbing	10
54	33000	1¾	1700	2000		180	stoves	14
54	45000	2¼	1400	1500		160	light	12
54	43000	3	1750	3000		370	heavy	12
54	19000	1½	1400	4000	3000	400	light	10
54	30000	2	2000	2400	.	240–400	gen'l machining	11
54	15000	8	2100	2400		250	light	16
54	38000	2	1400	2000	.	220	light	.
54	18000	1	1900	4000		500	light	10
54	65000	2½	1600	4500	3000	last 300 (275)	heavy mach'n'g	14
54	75000	3	2700	3000		280	light	18
54	75000	4	1400	2000	.	225	radiators	13
54	24000	2	2000	3400	2400	250	jobbing	12
56	40000	1¾	1000	2500	.	300	light	14
56	60000	2	3200	3000	...	300	radiators	12
56	60000	3	1600	4000	..	400	gas engines	..
56	100000	4½	2100	3500	..	350	gas engines	..
56	120000	5	2500	3000	..	300	textile mach'y	12
56	106000	7	2800	4000	3000	400	water pipe	7
56	12000	1	1700	4000	..	450	gen'l machinery	16
60	49000	2½	2400	4000	...	400	textile mach'y	14
60	70000	2	2200	3000	...	300	agricultural	8
60	18000	1	1700	4000	...	450	gen'l machinery	16
60	46000	3	2250	4000	...	400	gen'l machining	14
60	50000	2	2200	7000		650	machine tools	16
60	30000	1	5100	8000		900	chilled rolls	16
60	80000	4	3000	5000		900	rolling mill	10
60	80000	3½	2600	5000		600	soil pipe	12
60	75000	3	2400	3000	...	300	gen'l machinery	16
60	48000	3	2500	4000	....	500	soil pipe	10
60	40000	2¼	2000	4000	....	600	gen'l jobbing	13
60	16000	1	2100	4000	....	700	gen'l jobbing	8
60	60000	3	2000	2600	....	320	light work	14
60	60000	3	2000	3000	...	300	heavy mach'y	14
60	32000	1¾	1400	2000	....	225	stove plate	15
60	32000	2	1400	1000	....	[illegible]	gen'l machinery	..
60	80000	3	2000	4000	....	450	soil pipe	..
60	22000	2	2300	4000	2000	400-375	stoves	12
60	70000	3	2000	4200	....	500	soil pipe	10
60	37000	1¾	2000	3200	....	400	stoves	12
60	45000	4½	1200	1000	....	200	auto engines	...
60	10000	1	1000	2000	....	250	stoves	16
60	40000	2	2000	4000	....	400	jobbing	14
60	60000	2½	2300	4000	3000	330	stoves	..
60	36000	1½	1800	2500	....	300	light	..
60	64000	3½	2100	4000	2000	320–240	light	14
60	33000	2½	1850	2500	....	240	light	8
60	38000	1½	2000	2000	....	245–210	stove	12
60	80000	7	1000	2000	....	200	converter	..
60	30000	1¾	1850	3300	....	400–200	jobbing	12

(Concluded on page 674)

A TYPICAL INSTALLATION IN A FOUNDRY MAKING CONVERTER STEEL CASTINGS—NOTE THE HIGH WIND BOX ON THE CUPOLA TO THE RIGHT

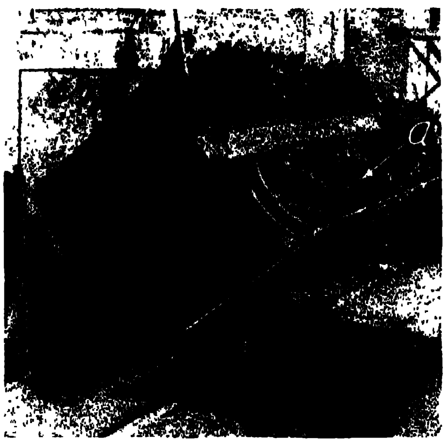
conditions where a blast furnace company operates its own coke ovens and ships the coke direct to the furnaces where it is used every day, a considerable amount of fine coke or breeze is developed, which is harmful in either furnace or cupola.

Railroad Snarl Responsible

Another reason why blast furnace plants do not stock coke is on account of the extremely high prices prevailing at the present time. Blast furnace operators know that there is a certain approximate relation between the price of coke and the price of iron and when the price of coke exceeds that figure they know they cannot produce pig iron at a profit. To cover existing contracts many blast furnace plants have been forced to buy spot coke in the open market recently and none of them feels like entering into long term contracts at the present price.

The coke oven plants do not maintain stock piles. The principal reason for this being that coke which has been exposed to the weather is not looked upon with favor either by iron producers or foundrymen. Even if that reason were not present, few co[illegible]ven plants have the yard area in whi[illegible] store up great quantities of coke an[illegible] they had the space, the extra time and labor involved in conveying and handling the coke so many times would add materially to its cost.

The nation-wi[illegible] shortage of cars and general snarl in which the railroads of the country are involved also have a direct bearing on the coke situation. The mine operators claim that they cannot secure enough cars to keep their mines working to capacity. The coke men say that coal which should come to them is diverted into other channels and therefore they cannot make enough coke to supply even a limited demand. The feature of the car situation which hits the coke men hardest is that they can get no definite assurance as to what time empty cars will be



A SECTION OF THE CHARGING FLOOR IS MOUNTED ON TRUNNIONS—A CLAMP PREVENTS THE CAR FROM FALLING OFF

assigned them and further, they must accept the cars when they do arrive whether they are ready for them or not, and the cars will be taken away again after 24 hours, irrespective of whether they are loaded or not.

The last rule may be the means of having a car cover a certain designated area in schedule time and conform to a carefully thought out plan which embraces the movement of a fleet of freight cars, but its efficacy in relieving the congested freight situation is extremely doubtful when it is remembered that about half the time these same cars may travel light on account of the freight at some points on their journey not being ready the minute the cars were spotted.

This practice of spotting cars at unexpected time and snatching them away again at a given time whether they are loaded or not has further tended to embarrass the coke-oven men. The temptation to load 30 and 36-hour coke is strong, if a string of cars is run into the plant when the ovens are at that stage. If the operators refuse to accept the cars and keep the coke in the ovens for the full 72-hour period, they run the risk of not being able to get any cars when they are ready to load them. If they accept the cars and load them with fuel that has not been thoroughly "coked" they are instigating a series of annoying experiences for the blast furnace or foundry which receives the coke.

Uninterrupted Operation Imperative

If ever a body of men were between the devil and the deep sea it is the coke oven men in this present year of grace. To operate a coke oven plant with any degree of success it is essential that there be a steady and uninterrupted flow of coal arriving on one side and a steady flow of coke leaving the other. Anything which tends to interfere with either

TO OBVIATE HANDLING THE COKE A SECOND TIME IT IS DUMPED DIRECTLY FROM THE WHEELBARROWS INTO THE CHARGING DOOR

TABLE I

Representative Reports on Cupolas 24 to 28 Inches Inside Diameter

(Concluded from page 672)

Diameter in inches	Total Charge pounds	Time hours	Bed Coke pounds	Iron Charge pounds 1st charge	Iron Charge pounds others	Coke Charge pounds	Class of work	Blast oz.
64	150000	7½	3200	5200	.	520	car wheels	8
64	80000	3½	2200	4500	3100	365	heavy	12
66	40000	1½	6000	9000	.	1000	heavy mach'y	10
66	135000	7	3600	4500	3500	420	cast iron pipe	8
66	110000	8	3200	3000	.	550	automobile engines	16AR
66	60000	2½	2000	5000	4000	350	light work	15
66	70000	2½	3000	3000	2500	400-325	stove plate	14
60	100000	6½	3000	8000	4000	500	loco-motive	12—350 coke 150 Hcoal
66	28000	1½	2500	5000	..	500	jobbing	10
66	45000	2½	2500	2000	...	200	stoves	14
66	100000	4½	3300	6000	5000	600	jobbing	14
66	80000	3½	2520	7500	5000	560	light	12
66	64000	2	1625	4000	.	550	light	14
66	44000	2½	2850	4000	2000	375	light	9
66	40000	1¼	2100	6000	4000	600	jobbing	16
72	200000	6½	4500	5600		560	car wheels	8

Diameter in inches	Total Charge pounds	Time hours	Bed Coke pounds	Iron Charge pounds 1st charge	Iron Charge pounds others	Coke Charge pounds	Class of work	Blast oz.
72	175000	6	3900	5600	.	560	car wheels	8
72	50000	2½	3000	8000	4000	275	heavy	14
72	100000	2½	7700	10000	...	1700	heavy mach'y	16
72	335000	10	4000	8300	.	800	car wheels	8
72	120000	4	2600	10000	...	1000	machine tools	16
72	100000	5	2800	2500	...	280	gas engines	16
72	130000	5	3000	4500	..	550	automobiles	16
72	86000	3½	4200	6000	.	600	gas engines	10
72	50000	1½	3800	2000	.	240	agricultural	15
72	60000	3	2400	5000	.	500	heavy mach'y	10
72	100000	4	2250	2500		500	agricultural	8
78	220000	8	6600	6000		775	car wheels	8
78	110000	3½	2650	4000	.	324	pipe fittings	..
78	220000	8	4500	6000	...	1100	automobiles	16
78	112800	3	4200	6800	...	680	light	18
78	430000	12	5000	6800	....	680	car wheels	8
84	100000	3	4500	10000	9000	1000	jobbing	16

of these operations will make trouble. When the ovens are drawn it is necessary to have cars available to haul the coke away. It also is necessary to have a supply of coal on hand so that the ovens may be recharged without loss of time. The uncertain railroad service is not conducive to these conditions and as a result the coke men are handicapped seriously in their efforts to meet production schedules or to fill their orders.

THE FOUNDRY on several occasions recently has directed attention in its editorial columns to this anticipated and seemingly inevitable shortage of coke this winter, and has urged foundrymen to check up their cupola practice with a view toward fuel conservation. Considering the present almost prohibitive price of coke any advice or comment might seem superfluous; but anyone who is practically intimate with cupola operations in this country knows that the majoirty of foundries conduct this vital branch of their business in a more or less indifferent manner.

The superintendent or foreman issues instructions to the cupola man covering the proportions of iron and coke to be used and then promptly dismisses the matter from his mind. The cupola man frequently has ideas of his own and institutes changes both in the height of the bed and the relative weight of coke and iron in the charges, sometimes with, but more often without, the formality of consulting either foreman or superintendent. So long as the metal is satisfactory to pour, the latter is not particularly interested. The original charging sheet is retained in the office and the clerk fills out a duplicate every night for the advice of the cupola man. The latter signs it, hangs it on a nail and pays no more attention to it. He charges the cupola according to his own judgment and is willing to tell the world that if he ever quits, the company will never be able to replace him.

This is not universal practice. Many foundries are supervised by competent men who know how to melt iron in the most efficient and economical manner. They not only know how to do it but they can instruct their cupola men, and more important than all else, they arrange to spend enough of their own time on the charging floor each day to see that instructions are carried out. This is as it should be. The cupola is the heart of the foundry and if the metal is not melted prop-

TABLE II

Maximum and Minimum Reports on Cupolas 24 to 28 Inches Inside Diameter

Diameter in inches	Total Charge pounds	Time hours	Bed Coke pounds	Iron Charge pounds 1st charge	Iron Charge pounds others	Coke Charge pounds	Class of work	Blast oz.
24	14000	5	500	1480	980	50	converter	:
24	4500	1½	395	400	400	35	jobbing	.:
28	4500	1	350	500	500	120	light	.
28	2000	½	350	1250	750	40	jobbing	5
30	12000	2½	600	800	800	75	agricultural	8
30	4200	1	525	1000	800	80	light	..
32	20000	3	1000	1000	1000	125	auto	8
32	8000	2	500	1000	1000	85	jobbing	8
34	12000	1¼	800	2500	2000	150	jobbing	8
34	8000	1½	500	1200	1200	150	jobbing	12
36	42000	6	450	600	600	80	light	12
36	18000	1	800	1000	1000	160	stoves	16
38	12000	1¼	850	1000	1000	100	stoves	14
38	7000	1¼	500	1500	1000	100	jobbing	12
40	36000	4½	900	2000	2000	350	light	8
40	6500	1	1000	2000	1500	200	jobbing	14
42	60000	7	1800	1500	1500	150	converter*	..
42	8000	1	1200	2500	2500	200	light	8
44	36000	2½	1500	2000	2000	200	light	16
44	25000	1½	600	2000	2000	200	jobbing	5
46	30000	1¾	1000	1200	1200	(400 on 150 10th chg)	machine tools	10

Diameter in inches	Total Charge pounds	Time hours	Bed Coke pounds	Iron Charge pounds 1st charge	Iron Charge pounds others	Coke Charge pounds	Class of work	Blast oz.
46	16000	1¼	1200	2000	2000	200	jobbing	12
48	96000	5	1800	1500	15000	175	converter	..
48	20000	1¼	1200	2000	2000	300	light	..
52	88000	4	2600	4000	4000	400	valves	14
52	15000	1½	550	1000	1000	102	pumps	14
54	90000	3½	1500	1500*	1500	150	mining machinery	6
54	21000	1½	2000	3000	3000	350	jobbing	14
56	120000	5	2500	3000	3000	300	textile	12
56	40000	1⅝	1000	2500	2500	300	light	14
60	70000	2	2200	3000	3000	300	agricultural	8
60	50000	7	1000	2000	2000	200	converters*	..
64	150000	7½	3200	5200	5200	520	car wheels	8
64	80000	3½	2200	4500	3100	365	heavy	12
66	135000	7	3600	4500	3500	420	cast iron pipe	8
66	40000	1½	6000	9000	9000	1000	heavy	16
72	335000	10	4000	8300	8300	800	car wheels	8
72	120000	4	2600	10000	10000	1000	machine tools	16
78	430000	12	5000	6800	6800	680	car wheels	8
78	110000	3½	2650	4000	4000	325	pipe fittings	..
84	100000	3	4500	10000	9000	1000	jobbing	..

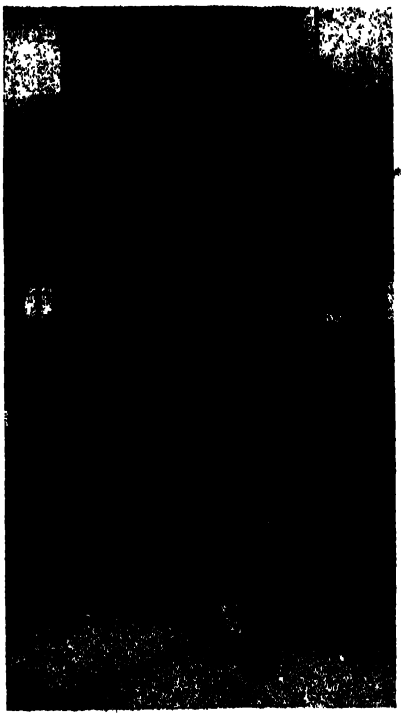
erly the most perfect supervision over the other departments simply is wasted effort.

With a view to showing the widely divergent opinions held by men who melt iron in cupolas, THE FOUNDRY sent a questionnaire to over 600 foundries located all over the United States and Canada and manufacturing all classes of castings. The tabulated returns from 231 are shown in Table I. While not by any means a complete list, this is fairly representative and probably reflects American cupola practice as truly as it would did it comprise reports from every foundry in the country.

Medium Sized Cupolas Popular

An interesting feature of this investigation, though without any bearing on the coke situation, is that approximately 60 per cent of the total tonnage of gray iron is melted in 36, 48, 54 and 60 inch cupolas. The remaining 40 per cent is divided up among 18 different sizes, ranging from 24 inches inside diameter to 84 inches which was the largest size cupola from which a report was received.

Many of these reports indicate that



THE CHARGING CARS PASS OVER A SCALE SITUATED CLOSE TO THE CHARGING DOOR

the practice in these particular shops could not be improved. Several were accompanied by supplementary letters which showed that the writers were in close personal contact with the melting conditions in their respective shops and fully alive to the importance of keeping accurate records. Others again indicated only indifferent practice, while a sufficient number were so palpably sheer guess work that they helped to bear out the statement made a little earlier in this article that haphazard methods prevail to an astonishing degree.

For obvious reasons no names are given and it is quite probable that the authors will not recognize some of these figures when they see them again. Among the statements which challenged attention and which is not published it one to the effect that the writer is melting 14,000 pounds of iron an hour in a 30-inch cupola. Another claimed to be using a 1600 pound charge of iron in a 34-inch cupola, which of course is not extraordinary, but when he set down 65 pounds of coke as the amount he used between the charges, it must be admitted that if every one were like him there would be no need to worry over a coke shortage, now or at any other time.

Table I shows the returns just as they were received and grouped according to cupola diameters. The second table is made up of minimum and maximum reports; two reports for each size of cupola, the contrasting reports being based on the amount of iron melted at each heat. Table III is prepared in accordance with the results of numerous tests conducted by competent authorities and represents what may be considered standard American cupola practice.

One important factor and one which has a direct bearing on the relative height of the coke bed; viz: the height of the tuyeres, was omitted from most of the reports received. In fact this point was touched upon by such a comparatively small number of foundrymen that it was of no value as a basis of comparison. Another point on which there appeared to be a considerable amount of misapprehension was in regard to the proper manner of indicating the elapsed time required to melt the heat.

A few foundrymen indicated that the time included from the minute the wind went on until the bottom dropped, which of course is the proper way, if one is to draw any accurate conclusions in regard to the melting speed of any two given cupolas operating under apparently similar conditions. Two cupolas may melt at the same speed after the metal appears at the tap-hole, but the one may have been in blast anywhere from 5 to 20 minutes longer than the other before the first iron appeared.

It is an established fact that the incandescent zone in a cupola is located at a definite point above the tuyeres and consequently the iron charged on an exceptionally high bed, that is, a bed extending to an exceptional height above the tuyeres, will not melt until the coke has been burned away sufficiently to bring the iron down to the melting zone.

From the foregoing it readily will be apparent that although two cupolas of the same inside diameter may carry the same amount of coke on the bed, the cupola with the high tuyeres, which in this case means the tuyeres

PANS AND COKE CANS ARE LOADED IN THE STOCK YARD AND DEPOSITED ON A LANDING COMMUNICATING WITH THE CHARGING FLOOR

nearest the top of the coke bed will require a shorter time to bring down the initial charge of iron than the cupola in which the tuyeres are located closer to the bottom. However, it must be remembered that if the coke bed were lowered to the same relative height above the low tuyeres, the iron would melt just as fast and at a material saving of coke.

Locate Tuyeres Low

The lesson to be drawn from this is that the tuyeres should be located as low as is consistent with the amount of iron to be held in the cupola before each tap. This practice will result in a correspondingly low bed. This fact will be better appreciated when it is remembered that the amount of coke *below* the tuyeres has absolutely no bearing on the heat of the iron nor on the speed of melting.

As already pointed out the melting takes place at a certain definite point *above* the tuyeres, that point depending on the quality of the coke and the pressure and volume of the blast. The first iron should appear at the

THE IRON CHARGES ARE DUMPED BY AN AIR HOIST; BUT THE COKE BUGGIES ARE DUMPED BY HAND

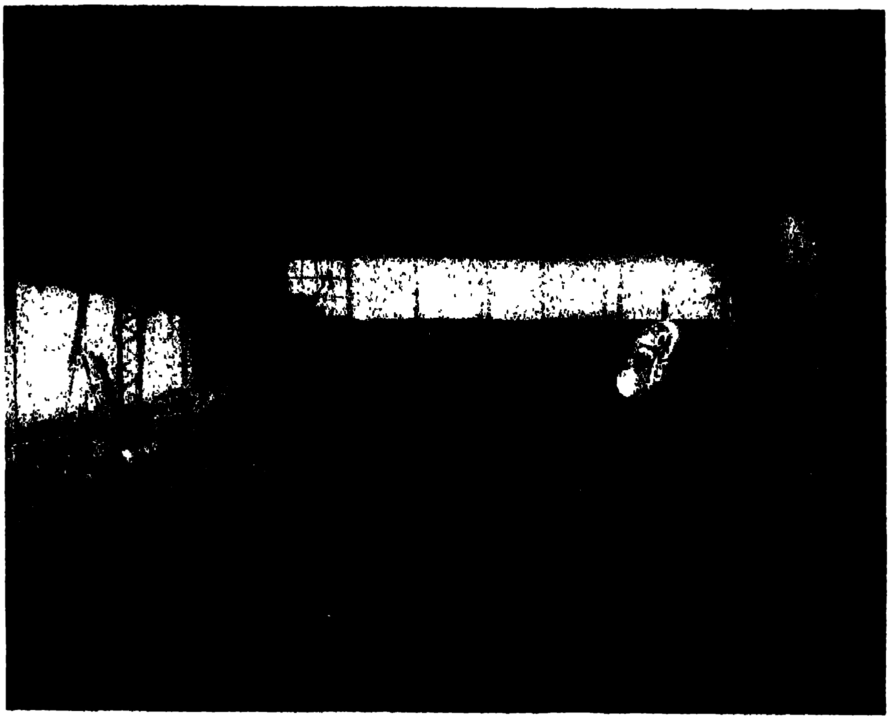
tap hole about 8 minutes after the wind goes on. If it does not appear in that time it will pay to make an investigation. It may be that the coke bed is the correct height but the blower is not delivering sufficient quantity of air.

Approximately 30,000 cubic feet of air are required to melt one ton of iron. A cupola should melt about 10 pounds of iron an hour for every inch of horizontal area at the tuyeres. With these two factors it is a simple calculation to find how much air should be delivered into any size cupola in a given time. If the blower is not delivering the required volume of air it should be attached to a more powerful motor; while on the other hand, if an investigation discloses that it is delivering air up to its capacity it should be replaced by a larger unit. If it is found that the blower is delivering a sufficient quantity of air for the rated melting capacity of the cupola then it is apparent that the coke bed should be lowered. After the cupola has been in blast for some time there is a possibility of miscalculating the volume of blast entering into it on account of the tuyeres partially closing; but there is no obstruction for at least half an hour after the wind goes on and any observations made during that time are likely to be accurate. In these days, when coke is both scarce and high, a difference of 6 inches in the height of the bed will mean anywhere from $1 to $10 a day, depending on the size of the cupola and a corresponding saving in the total amount of coke necessary for the daily operation of the cupola. The same rule also applies to the amount of coke used between the charges. A ratio of 1 to 10 long has been regarded as good melting practice and only possible when good coke is available. There is no economy in skimping the coke if the character of the castings, the distance the molten iron has to be conveyed, or the number of times it must be rehandled demands superheated metal at the cupola spout. Foundries engaged in the production of light work and those specializing in castings for the automotive industry claim it is necessary to employ a ratio of 1 to 5 or 6.

Among the many points of difference shown in the 36-inch cupola reports perhaps the most remarkable is that between two which report the same amount of coke on the bed, 700 pounds, the same weight of iron and coke charges, 1000 pounds of iron and 100 pounds of coke. The similarity between the two ceases with these factors. The first report shows that 20,000 pounds of iron were melted in 2½ hours; or at the rate of 8000 pounds per hour. The second report indicates that it required 2 hours to melt 10,000 pounds or only about 5000 pounds an hour.

One 48-inch cupola is shown as melting 20,000 pounds an hour; while a second admits to 7500 pounds and between these there are reports indicating 12,000, 14,000, and 16,000 pounds as the amounts melted hourly.

Reading this article will be of no particular value to the man who already is operating on an efficient basis. However, it should prove both of interest and value to the great majority of foundrymen for as the report indicates, there is a sad lack of unanimity in cupola practice. Reference to the man who is operating his cupola at the highest point of efficiency does not mean the one whose shop records show the greatest economy; but rather the man who knows from actual observation that these



THIS FOUNDRY IS BUILT ON THE SIDE OF A HILL; THE STOCK YARD IS LEVEL WITH THE CHARGING FLOOR—COKE IS LOADED INTO A POCKET ON THE ROOF AND IS DISCHARGED ONTO THE CHARGING FLOOR BY GRAVITY

TABLE III
Relative Charges of Coke and Iron

Diameter in inches	Area feet	Bottom of tuyeres	Height of bed	Coke in pounds	Coke charge	Iron charge	Pounds per hour
24	3	6	3' 3"	280	60	600	4,328
30	5	8	3' 6"	490	100	1000	7,068
36	7	10	3' 8"	718	140	1400	10,178
42	9½	12	3' 10"	1020	190	1900	13,854
48	12¼	14	4' 2"	1488	250	2550	18,095
54	16	16	4' 4"	1932	320	3200	22,902
60	19½	18	4' 6"	2437	300	3900	28,274
72	28	20	4' 8"	3612	560	5600	40,714

records are correct and correspond to actual conditions. There is no department around a foundry in which actual and assumed conditions may differ as widely as they can around the cupola; and broadly speaking, there is no department which receives as little attention.

A cupola will function satisfactorily under a wide range of conditions and that is the principal reason why so many foremen are averse to experimenting with a view of finding the ideal condition. They act on the principle that it is best to let well enough alone. Of course, when a new cupola is installed during a foreman's tenure of office he probably will experiment more or less, depending on his initiative, before he makes out an arbitrary charging card. However, in the great majority of cases, the cupola and the charging practice antedate the foreman and as long as the iron comes down good and hot, he does not worry how it is done. In many instances any tendency on the foreman's part to change long established melting practice, is frowned upon by the management.

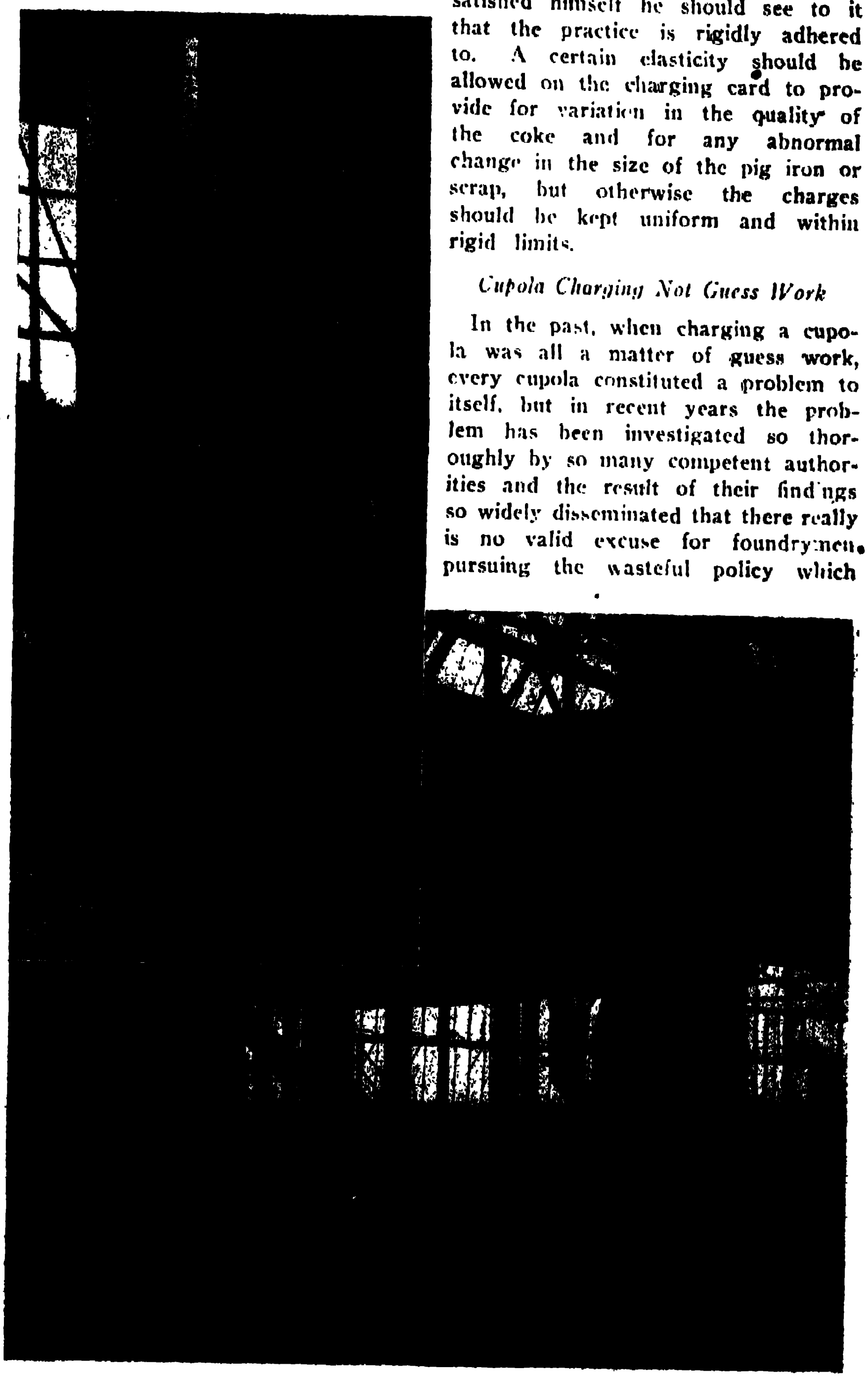
Too Much Coke Charged

The only time the foreman interviews the melter is when the iron happens to come down dull. Now dull iron may result from any one of several causes, but as a general rule no investigation is held. It usually is blamed on the amount of coke used. Applying the principle that if a small lemon is sour, a big one should be sourer, additional coke is used on the following day. It may happen that the conditions leading up to the dull iron are not present on this occasion and, as the additional quantity of coke does not make the hot iron any hotter therefore the amount of coke is left at the advanced figure and becomes the established practice. When this happens a few times, there is practically twice as much coke going into the cupola as is needed and any attempt to reduce it is viewed with horror by the melter who is sure that if the iron does melt, of which he is doubtful, it will be too cold to use. Castings may be hard or soft, strong or weak, smooth or rough, dirty or clean and no one thinks of speaking to the melter about it; but if the iron is dull he receives all the blame. Then, it is only natural that he should concentrate on that one point and disregard everything else in his endeavor to supply iron that will smoke in the ladle.

Hot iron is a prime necessity in the foundry and it would indeed be false economy to reduce the coke ratio to a point which would not produce iron of the proper temperature, but there are such things as *enough* and *too much*. Every foundryman who has supervision over a cupola should exercise that supervision in a practical manner and satisfy himself by study, observation and investigation that his practice really is efficient, and having satisfied himself he should see to it that the practice is rigidly adhered to. A certain elasticity should be allowed on the charging card to provide for variation in the quality of the coke and for any abnormal change in the size of the pig iron or scrap, but otherwise the charges should be kept uniform and within rigid limits.

Cupola Charging Not Guess Work

In the past, when charging a cupola was all a matter of guess work, every cupola constituted a problem to itself, but in recent years the problem has been investigated so thoroughly by so many competent authorities and the result of their findings so widely disseminated that there really is no valid excuse for foundrymen pursuing the wasteful policy which



A SMALL PORTABLE CUPOLA—THE CUPOLA IN A STOVE SHOP IS PLACED IN THE CENTER OF THE BUILDING

many of them are doing. This is particularly true at the present time when every effort should be made to conserve coke.

A certain amount of experimenting may be necessary to determine the highest point of efficiency at which any individual cupola may be operated; but several broad, general principles have been established and are shown in Table III. In addition to the examples shown, the following rules are submitted for the guidance of those who wish to do their own calculating.

A cupola should melt 10 pounds of iron per hour for each inch of area at the melting zone.

The area of any circle is found by squaring the diameter in inches and multiplying the result by 0.7854. For example, a cupola 36 inches in diameter would have an area of (36x36) x 0.7854 or 1017.85 inches. Thus, by applying the foregoing rule, such a cupola should melt 1017.85 x 10 or 10,178.5 pounds of iron an hour.

Coke weighs approximately 28 pounds per cubic foot and for that reason it will be necessary to reduce the area to square feet and multiply by the height, also in feet. The height of the tuyeres will determine the height of the bed and therefore as a measure of economy the tuyeres should be placed as low as possible. Special conditions may make it necessary to provide exceptionally low or exceptionally high tuyeres. The former condition is met in shops where the iron is allowed to run in a constant stream and the latter where a maximum amount is gathered before tapping as in cupolas operated in connection with bessemer converters and heavy-work foundries. The average height of tuyeres for cupolas between 24 and 72 inches inside diameter, is given in Table III.

Limit Height of Bed

With exceptionally good coke, a bed 24 inches above the tuyeres will produce satisfactory iron; but with coke of uncertain quality it may be necessary to carry the bed to a height of 30 inches. If it should be necessary to carry the bed higher than 30 inches above the tuyeres, it is an indication that something is radically wrong.

Cold iron at the first of the heat frequently is blamed on a low bed when in many cases it should be ascribed to a hard or wet bottom; wet lining or a bed not burned up properly.

With the foregoing data, the weight of coke for the bed of any diameter cupola readily can be calculated. Multiply the area of the cupola in feet by the height of the required bed, also in feet and then multiply the result by 28. This will give the result in pounds. Using the former illustration, it is noted that a 36-inch cupola has an area of 1017.85 square inches. Dividing this by 144 the area is found to be 7 square feet. The top of the tuyeres in the average 36-inch cupola will be 14 inches above the sand bottom, and an additional 30 inches for the bed would give a total height of 44 inches, or 4 2/3 feet. Therefore, to find the weight of coke necessary for the bed it only is necessary to multiply 4 x 4 2/3 x 28 which is equivalent to 718 pounds.

Bed Charged by Volume

Some kinds of coke are heavier than others bulk for bulk and where there are no facilities for weighing the coke readily every day, the bed can be charged by volume. Having determined the most satisfactory height at which the cupola operates, probably between 24 and 30 inches above the tuyeres, a light iron rod may be bent at one end and lowered inside the cupola until the long toe on the end rests on the coke. The other end then is bent in the opposite direction, the whole rod resembling the letter Z, one end resting on the coke and the other end resting on the sill of the charging door. This rod may be used as a gage in charging by volume.

Whether the coke is weighed or measured, enough to form a layer approximately 4 inches thick should be held in reserve and added after the bed has burned through. The air inlets in the wind box then should be closed and the cupola filled to the charging door.

Probably there is more divergence of opinion among foundrymen over the proper weight of the charge than over any other feature of cupola operation. A glance at the figures in Table I will show that practically no two of any given size cupolas are charged alike. The majority have one feature in common; their charges are uniform throughout the duration of the heat. It is the custom in some shops to make the first charge heavier than the others, in some cases twice as heavy; but the benefit is problematical from an economical standpoint, since it is necessary in such cases to increase the amount of coke on the bed by practically the same amount as would have been required if the charge had been split in two and coke used between.

The following rule may be employed to find the approximate weight of iron and coke to use in charging a cupola. Multiply the area of the cupola at the melting zone in square feet by 200 which will give the result in pounds of iron; the coke may be figured from that in the ratio of 1 to 10. For example, the area of a 36-inch cupola is 7 square feet; 7 x 200 is 1400, the weight of the iron charge. This at the indicated ratio of 1 to 10 will give a coke charge of 140 pounds.

Summing up, it may be said that the height of the tuyeres exert no influence on the heat of the iron, hot iron can be melted whether the tuyeres are high or low, but in the interests of economy and unless it is necessary to hold a considerable amount of iron before tapping, it is advisable to have the tuyeres as low as possible. Light, thin charges of iron and coke will produce hotter iron than thick, heavy charges, but they should be made as heavy as the cupola will stand without affecting the quality of the iron.

Heretofore coke has been cheap and plentiful and always available whether in winter or summer. As a consequence, the average American foundryman has grown up to regard it carelessly. A barrowful or two extra on the bed was immaterial and four or five extra forkfulls on each charge; "to see if the old man would stop his growling about cold iron;" was considered ordinary practice. Furthermore, with a passion for neatness and tidiness which characterizes some people at the most inopportune times, the stage would be cleaned up at night by pitching all the remaining coke into the cupola.

The constantly soaring prices and the growing scarcity of coke at any price are influencing foundrymen more and more to give intensive and minute attention to their cupola practice. Even by the most rigid economy, it is extremely problematical at the present writing whether all foundries will be able to operate throughout the coming winter.

Histo[illegible] Foundry Sold

The his[illegible] West Point Foundry, Cold Spring, N. Y., which closed down a few years ago after the A. B. & J. M. Cornell Iron Works had operated it for several years, has been sold to the Astoria Silk Mills, Astoria, L. I., according to announcement. The silk mills firm will operate the foundry with 700 employes.

The first locomotive used in New York state, the old wood burner De Witt Clinton, was constructed at the West Point plant. In the civil war the plant was rushed with orders. Hundreds of Parrot guns were made.

SPECIFICATIONS FOR CAST-IRON SOIL PIPE AND FITTINGS*

I.—Manufacture

1. The cast iron from which the pipe and fittings are made shall be of such composition, and the conditions of manufacture so maintained, that the castings will be of uniform physical character, close-grain, and not hard, brittle nor difficult to cut with file or chisel.

2. (a) When pipe or fittings are to be coated, coal-tar pitch shall be used, which shall contain sufficient oil to make a smooth coating. The pitch shall be tough and tenacious when cold, and not brittle nor having any tendency to scale.

(b) The varnish shall be heated to about 300 degrees Fahr. and shall remain at this temperature during the time the casting is immersed.

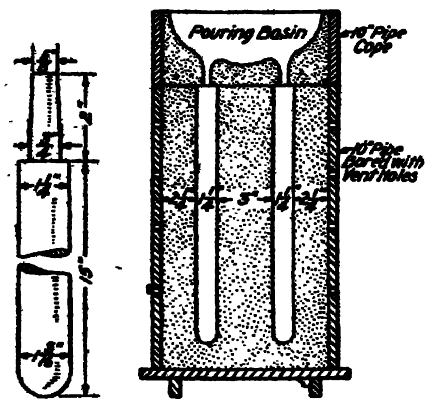


FIG. 1

(c) Each casting shall be heated to a uniform temperature of about 300 degrees Fahr. immediately before it is dipped, and shall possess this temperature at the time it is put in the bath.

(d) Each casting shall remain in the bath at least two minutes.

(e) Fresh pitch and oil shall be added when necessary to keep the mixture of the proper consistency, and the vat shall be emptied of its contents and refilled with fresh pitch whenever the accumulation of sand or carbonaceous matter renders this desirable, as can be seen by the solids adhering to the under side or lower ends of the castings.

(f) After being coated, the pipe and fittings shall be carefully drained of the surplus varnish.

II.—Chemical Properties and Tests

3. Drillings taken from the fractured end of the arbitration test bar shall not contain over 0.10 per cent of sulphur.

*Adopted as standard by the American Society for Testing Materials, 1918.

(Continued on Data Sheet No. 348)

SPECIFICATIONS FOR CAST-IRON SOIL PIPE AND FITTINGS

(Continued from Data Sheet No. 347)

III.—Physical Properties and Tests

4 The transverse test specimens (arbitration test bars) specified in section 7, when placed horizontally upon supports 12 inches apart and tested under a centrally applied load, shall conform to the following minimum requirements:

AVERAGE LOAD AT CENTER, LB.	2500
AVERAGE DEFLECTION AT CENTER, IN.	0.10

5. All pipe shall be tested to a hydrostatic pressure of not less than 50 pounds per square inch before coating. Any casting showing defects under this hydrostatic test shall be promptly broken and returned to the cupola.

6. The form and dimensions of the mold for the arbitration test bar shall be in accordance with Fig. 1. The bottom of the bar shall be 1/16-inch smaller in diameter than the top, to allow for draft and for the strain of pouring. The pattern shall not be rapped before withdrawing. The flask shall be rammed up with green molding sand, a little damper than usual, well mixed and put through a No. 8 sieve, with a mixture of 1 to 12 bituminous facing. The mold shall be rammed evenly and fairly hard, thoroughly dried, and not cast until it is cold. The test bar shall not be removed from the mold until cold enough to be handled. It shall not be rumbled or otherwise treated, being simply brushed off before testing.

7. From each melt of metal not less than three test specimens (arbitration test bars) shall be poured, the first of which shall be poured within five minutes after the first ladle is tapped and the remainder at intervals not exceeding one hour throughout the melt.

IV.—Standard Sizes and Weights

8. (a) The inside diameter of the barrel of any pipe or fittings or branch thereof shall not vary more than ⅛-inch under the nominal size of pipe.

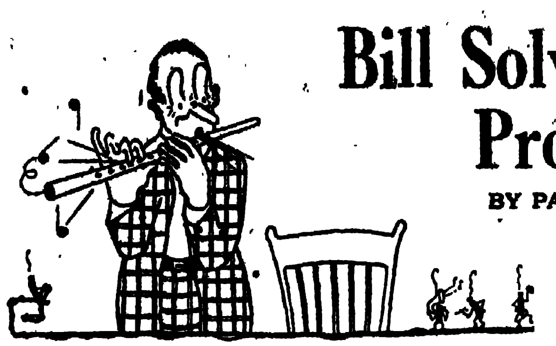
(b) The outside diameter of the barrel of pipe and fittings shall be ¼-inch greater than its nominal inside diameter A variation in the outside diameter of ⅛-inch over or under these figures will be permitted.

Table I

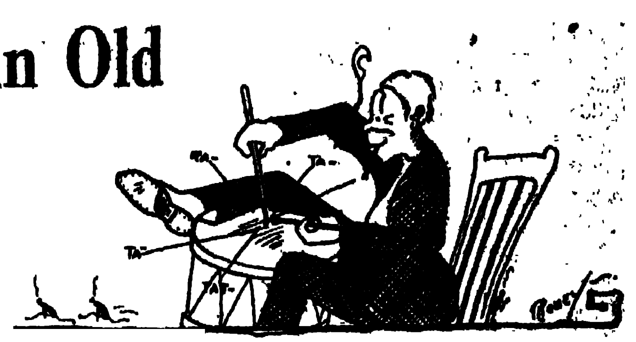
WEIGHT OF SOIL PIPE

Size, in.	Single Hub Per 5-ft. Length, pound	Per ft. Including Hub, pound	Double Hub Per 5-ft. Length, pound
2	27½	5½	27½
3	47½	9½	47½
4	65	13	65
5	85	17	85
6	100	20	100

(Continued on Data Sheet No. 349)



Bill Solves An Old Problem



BY PAT DWYER

BILL and I stood on a down-town corner the other day watching a parade. In those far away days, which now seem like a dream, Bill played a fife and I rattled a snare drum in an amateur fife and drum corps and when that organization broke up, as such things nearly always do, we offered our services to the town cornet band. After a few trials with an alto horn and a few visits to the dentist I decided that I would never make any reputation with that instrument; but Bill had a magnificent set of teeth and quickly developed a *lip* which influenced the band master to assign him the E-flat, solo cornet parts. To hear him do the cadenza in "Afton Water" was a treat, and when he triple tongued the E-flat parts in "The High School Cadets", "King Cotton", "The Stars and Stripes Forever", and other stirring compositions of the well known John Philip—a man who didn't feel like yelling *encore* must have been deaf or have had a soul like a cow.

The memories of a man's first love will remain with him all the days of his life, whether these memories center around a plug of tobacco or an angelic creature who wore a faintly scented, lilac sprinkled muslin dress and shyly said *yes* when he asked her blushingly if he might see her home from the first party. Therefore, it is only natural that when Bill and I see a parade, our interest centers in the bands.

On this occasion we sized them up critically and technically, but when a fife and drum corps passed, Bill insisted on quitting a perfe good vantage point, which we had and boring his way through a crow a distance of several blocks until the boys had finished a selection they were playing. "You can talk about your bands and orchestras," said he, "but for pure, exquisite pleasure; something that keeps your heart in your throat, and your feet stepping out on the sidewalk in time to the music, give me a memorial day parade with two old veterans, service caps cocked askew, playing fifes, and a third, alert and white haired, with his cap at even a more rakish angle, tapping a snare drum like an artist. Listen to "Yankee Doodle", "Marching Through Georgia," and the rattling, lilting crescendo measures of "Dixie" and it is easy to understand how men fought, bled and died during the red days from '61 to '65."

"What's the idea"? I said. "To hear you talk one would imagine you were a candidate for something, or else a professional spellbinder with an eye on the old soldier's vote."

"'Pon my word," said Bill. "Whenever I cast pearls before you I am almost forced to the conclusion that there is something in the theory of transmigration of souls. If there is I am quite positive that in a former incarnation you were equipped with a much longer snout and a curly tail."

He rapidly executed a strategic movement to the rear which brought his back up against a jeweler's plate glass window and dared me to throw any paving blocks at him.

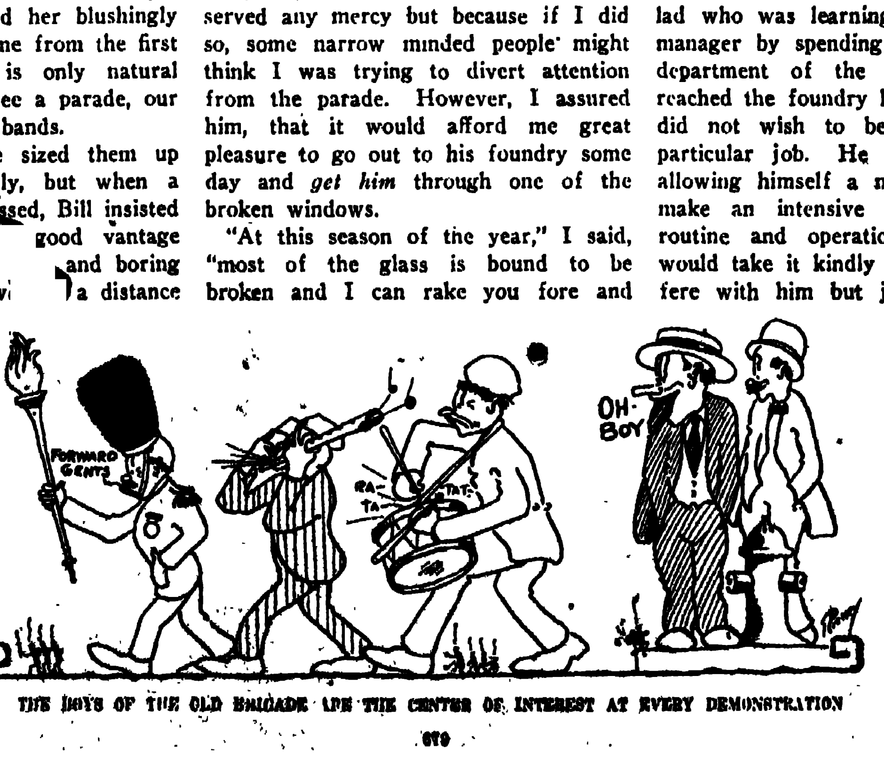
I abandoned the idea of beaning him; not, I assured him because he deserved any mercy but because if I did so, some narrow minded people might think I was trying to divert attention from the parade. However, I assured him, that it would afford me great pleasure to go out to his foundry some day and *get him* through one of the broken windows.

"At this season of the year," I said, "most of the glass is bound to be broken and I can rake you fore and aft. If that does not finish you, I'll bribe one of your cupola men to spill a wheelbarrow of pig iron on you as you pass under the stage."

"What you said about the windows is correct in the main," said Bill, "but I know of many foundries right now which have their full complement of windows but the glass in them is so covered with dirt and grime that they might just as well not be there for all the good they are. They serve one purpose admirably. They prevent the men inside from looking out and thus losing interest in their work, and they prevent vulgar people from gawking in at the workmen and thus embarrassing these sensitive, refined and high-strung artists.

"It is funny how climatic conditions affect the window glass in a foundry. You never see a broken window in the winter. Hail, sleet, snow or rain, it is all the same, the good old panes defy them all; but with the first balmy breath of spring they commence breaking at an alarming rate until by mid-summer there is not a whole sash in the place.

"I often have attempted to figure out this phenomenon and almost had reached the conclusion that a certain amount of intentional carelessness on the men's part was responsible when the question was settled for me by a bright young lad who was learning to be a general manager by spending a month in each department of the plant. When he reached the foundry he told me that he did not wish to be assigned to any particular job. He said he was only allowing himself a month in which to make an intensive study of foundry routine and operation. Therefore, he would take it kindly if I did not interfere with him but just let him make his own investigations and draw his own inferences. I assured him, truthfully, I hope, that nothing would give me greater pleasure; but I also said, which was not strictly a truthful statement, that I would appre-



THE BOYS OF THE OLD BRIGADE ARE THE CENTER OF INTEREST AT EVERY DEMONSTRATION

ciates any tips or advice he might feel inclined to give me from time to time. He gracefully admitted that he would be pleased to do so; but in view of the fact that his time was limited he intimated that I should make the questions as brief as possible, or, as he put it 'make 'em snappy.'

"I turned the proposition over in my mind for several days and finally decided that I would seek his advice on two foundry problems which I had never heard satisfactorily explained. The first was—Why do colored helpers always cut holes in their shoes? The other was the problem of the broken windows. On my way through the shop seeking the fountain of knowledge I was stopped by an old 'bo who had recently arrived from Alabama. He was engaged in making a 6-foot pulley and as he understood there was a big difference between Northern and Southern foundry iron he wanted me to advise him whether it was necessary to place a feeding riser on the hub. I told him to do so by all means and to be sure to feed it up well after it was cast. Having settled that point, it struck me that since he was probably familiar with conditions in the South he could explain the shoe enigma.

"He laughed when I asked him and said that he had nothing to prove it; but down where he came from it was the generally accepted belief that gentlemen of color *breathed* through their feet. He said that he had worked in a big plant down there where the management had instituted safety methods and among others had insisted on the foundry employes wearing congress shoes. They even went so far as to supply every man with a new pair, free, to encourage their adoption. The first day they had them on every colored helper in the place had cut a row of port holes on both sides along the water line. The old boy assured me that if he was running a foundry in the South he would shoe all the helpers like mules.

"With this weight off my mind I continued down the shop until I located the young man of whom I was in search. He was making an entry in his note book to the effect that molds left standing over night invariably produced bad castings on account of the facing sand getting sour. He stuck the note book in his pocket, pulled up one sleeve to note the time and then assumed, to the best of his ability, the facial expression and manner of speech ascribed to successful captains of industry by our leading novelists—you know, brows drawn down to indicate the most intense concentration, eyes darting out shrewd glances through half closed lids; etc. He addressed me in one of those short, crisp sentences which according to the same authorities is characteristic of the modern American financial giant.

"'Well, Bill,' just like that.

"I told him that I wanted his advice on a certain foundry problem; but before taking it up I asked him why he had looked at his watch when I had approached him.

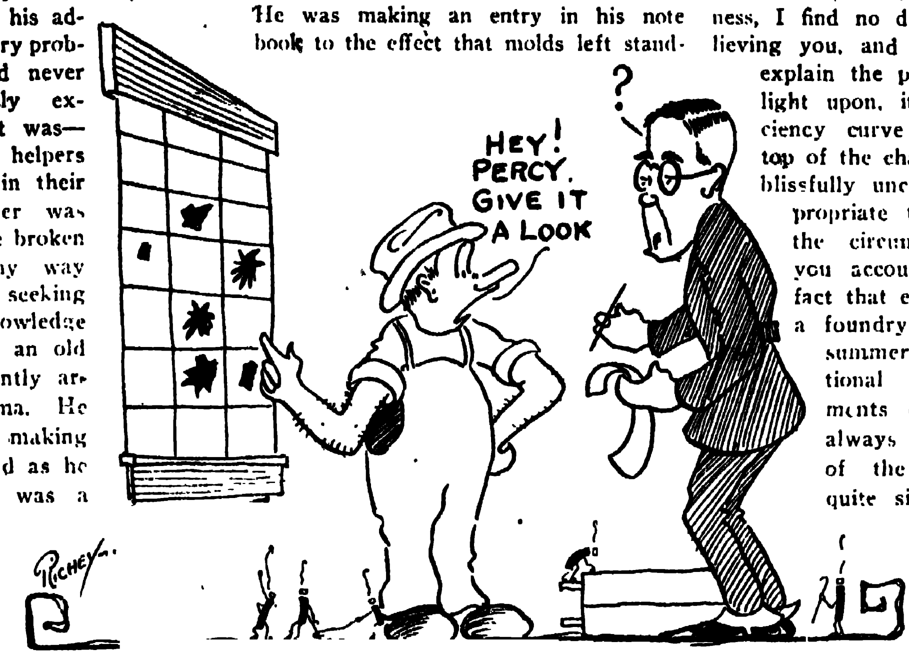
"'Part of my system,' said he. 'I time each one of my actions all day, then by plotting them on a chart at night and comparing the actual curve with a theoretical curve I can measure my efficiency. I really think that the time I devote to this part of my work each night is the most important thing I do all day.'

"'Fine business,' I said. 'Fine business, I find no difficulty at all in believing you, and I think if you can explain the problem I want some light upon, it will run your efficiency curve pretty well to the top of the chart.' 'Shoot,' said he, blissfully unconscious of how appropriate the term was under the circumstances. 'How do you account,' I said, 'for the fact that every window pane in a foundry gets broken in the summer time and the additional fact that the fragments of broken glass are always found on the outside of the building?' 'That's quite simple,' said he. 'The foreign material covering the glass has a different coefficient of expansion from the glass itself the heat from the sun's rays acting directly on the outside surface of the glass expands that side until it exceeds the elastic limit and then there is nothing left for it but to break. The curve on the outside throws the center of gravity beyond an imaginary perpendicular or vertical line on the face of the sash and consequently the glass falls on the outside of the building.'

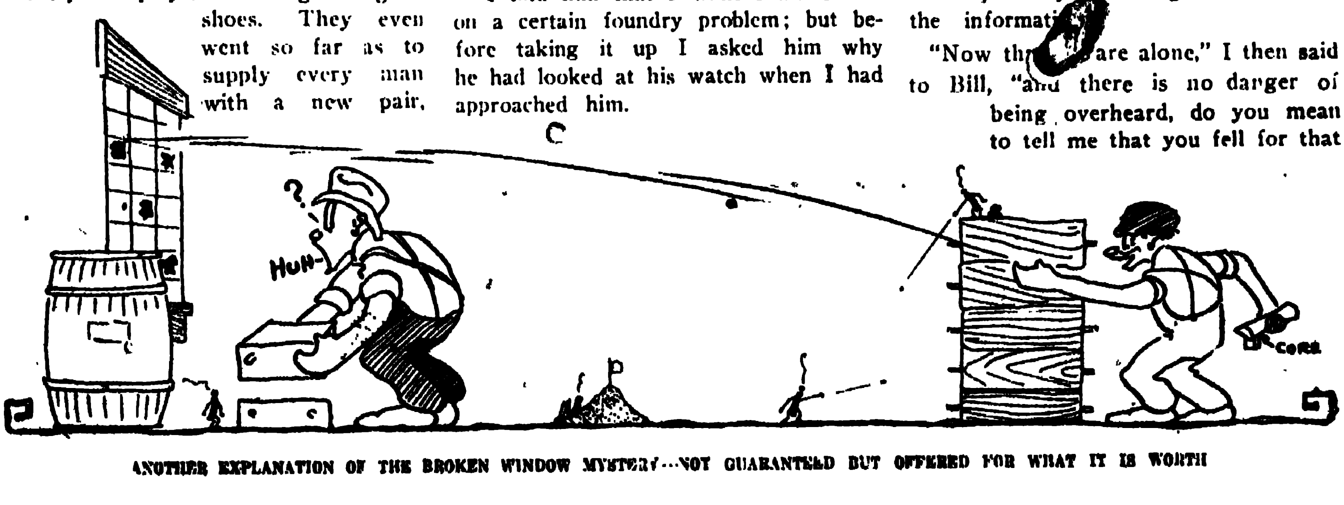
"He flipped out the note book, consulted the dinky little time piece, made an entry under the heading *Expert Advice* and said 'Anything else?'

"I said no, I did not think there was anything else worthy of his attention; but I certainly felt obliged to him for the informat[illegible]

"Now th[illegible] are alone," I then said to Bill, "and there is no danger of being overheard, do you mean to tell me that you fell for that



THE BROKEN WINDOW MYSTERY IS EXPLAINED IN A SCIENTIFIC MANNER.



ANOTHER EXPLANATION OF THE BROKEN WINDOW MYSTERY—NOT GUARANTEED BUT OFFERED FOR WHAT IT IS WORTH

line of bunk?" "That's the kind of question that no one never answers," said he. "You might just as well expect the apprentice boys to admit that they broke the windows after finding short, hard pieces of round stock cores among the debris. You can form your own opinion but you can't prove anything."

Chilled Edges Are Cause of Trouble

By H. E. Diller

Question.—We are having considerable trouble machining our gray iron cylinder castings on account of hard iron. Our chemist advises us that the iron contains: Silicon, 2.30 per cent; sulphur, 0.075 per cent; phosphorus, 0.650 per cent, and manganese, 0.70 per cent. He also says that it is not possible to further soften the iron and produce solid cylinder castings.

Answer.—We know of one foundry that is making cylinder castings from metal of practically the same composition as the iron you are using, and obtaining sound castings easily machinable. We think that possibly your trouble is from getting the edges of your castings chilled by having too sharp corners or the sand too damp. We have known foundries that have had this trouble caused by swabbing the corners of their molds with too much water. While their iron in the main body of the castings was soft and readily machinable, some of the corners of a few of the castings would be chilled and dull cutting tools.

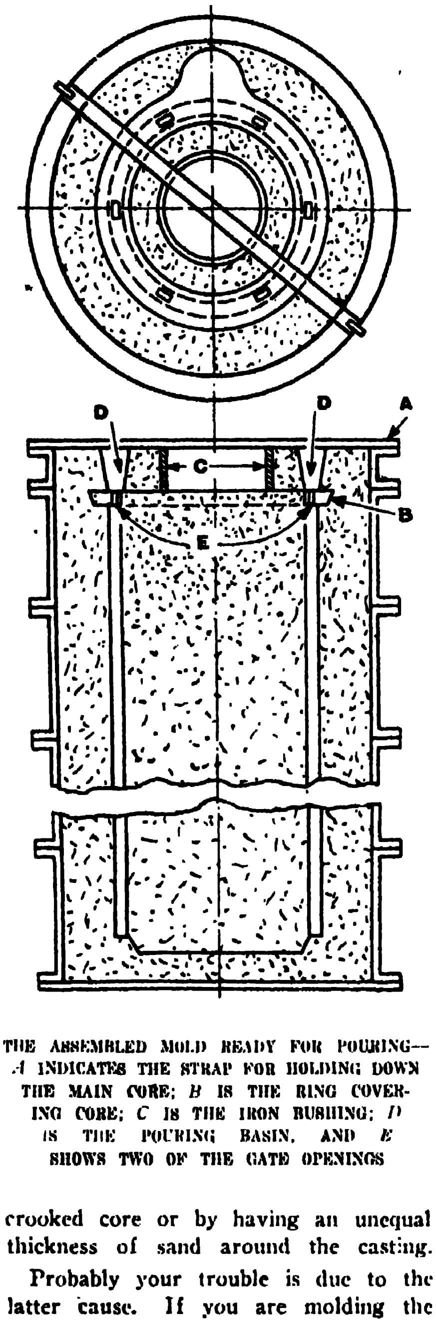
In general cylinder foundries use an iron with lower phosphorus content in order to insure castings free from porous spots. Many foundries carry the phosphorus in the vicinity of 0.200 per cent. We would recommend that you use a flux consisting of 25 pounds limestone and 2 pounds fluor spar per ton of metal. This should be placed on each charge after the second, toward the center of the cupola so as not to wash against the side walls.

Vertically Cast Hollow Rolls Are Warped

By Pat Dwyer

***Question*: I have been having trouble lately on account of rolls warping and would appreciate any information you can give me on the subject. The rolls are poured with gray iron in dry-sand molds. I made a dozen or more of these castings which were straight and satisfactory but the last three I have made are quite crooked. They are all the way from an inch to half an inch out in the center. The roll is 7 feet 6 inches long by 13 inches outside diameter. A straight core 9½ inches in diameter extends from end to end.**

Answer: Without further details it is impossible to say definitely what causes the castings to warp. It might be caused by a warped pattern; a



THE ASSEMBLED MOLD READY FOR POURING—A INDICATES THE STRAP FOR HOLDING DOWN THE MAIN CORE; B IS THE RING COVERING CORE; C IS THE IRON BUSHING; D IS THE POURING BASIN, AND E SHOWS TWO OF THE GATE OPENINGS

crooked core or by having an unequal thickness of sand around the casting.

Probably your trouble is due to the latter cause. If you are molding the roll on end in a round flask it is probable that the pattern is kept close to one side to allow room for the upright runner. If that is the case the roll invariably will warp because the heat from the thin side of the mold will radiate much faster than from the side carrying the runner. The thin side will contract first pulling the ends of the casting toward each other and springing the back. The other side will contract later, but cannot do so normally on account of the resistance offered by the side which already has set and become rigid. A familiar example of this phenomenon is seen in casting open-sand plates. If they are left to cool naturally after they are poured the ends will spring up. The common remedy for this is to shovel sand on the ends and leave the center uncovered, thus equalizing the cooling process.

The regular roll shops overcome this tendency to warp by providing extension pockets on the flask sections to carry the upright runner and thus are enabled to keep the roll in the center of the flask with an equal thickness of sand all around it.

Where rolls are only made occasionally and it is desired to run them from the bottom, square flasks are the best because the runner can then be kept in one corner.

In your case try round flasks; but instead of pouring the job from the bottom, pour it through six ¾ x ½-inch pop gates evenly spaced around the top. To insure a perfectly clean casting it might be advisable to dispense with ramming a cope. Instead a loose ring 1½ inches thick could be sawed out on the band saw and slipped over the top of the pattern. A round flat corebox corresponding to the shape and size of the ring and containing small upright pieces to form the gate openings could be used for making a cover core.

After the mold is dried and the upright core set the ring core dropped into place will center the upright core automatically. A wooden block to form the basin then is placed over the gate openings followed by a shallow flask ring which serves to hold the green sand which is rammed around the basin block. An iron bushing or other suitable packing on top of the upright core can be secured by a flat strap clamped across the top flange. The general arrangement is shown in the accompanying illustration.

Where cylindrical cored castings are molded horizontally in a split flask and afterwards upended for pouring, it sometimes happens that the mold is sprung in the center due to insufficient support under the center of the roll-over board while ramming the drag or the same condition prevailing after the mold has been rolled over. This will result in a thick and a thin side on the mold after the core is placed. When the casting is poured the thin side contracts first and the casting will be crooked irrespective of whether it is in the center of the flask.

A new blast furnace, with a capacity of 100 tons of sand-cast pig iron daily, has been put in blast at Hankow, China, according to reports to the department of commerce.

C P 1A 1219

TIME STUDY

DATE ______ DEPT NO ______ EQUIP NO ______

TYPE OF EQUIPMENT ______

SPECIAL FIXTURES ______

PART NAME ______

KIND OF MATERIAL ______

OPERATION ______

NO OF EMPLOYES ______

FORMER STD TIME HRS ______ FORMER PRICE $ ______ REFER TO REGISTER NO ______

REASON FOR CHANGE ______

STANDARD PROD PER HR ______ STANDARD TIME HRS ______ RATE FOR PRICE $ ______ PIECE PRICE $ ______

STANDARD COST $ ______ BASED ON AVE HOURLY RATE $ ______

REMARKS ______

PART NO ______ OPER NO ______ REGISTER NO ______

TAKEN BY ______ ON EMPLOYE NUMBER ______ CHECKED BY ______

APPROVED ______ APPROVED ______

(SEE DETAIL ON REVERSE SIDE)

DETAIL OF TIME STUDY

ITEM NO	OPERATION	TIME TAKEN MINS		TIME TAKEN MINS		ALLOWED MIN	
1	Place Flask		28				
2	Dust-Place Board		17				
3	Place Riddle & Facing		09				
4	Shovel & Riddle Sand		15				
5	Shovel & Ram Sand		34				
6	Place Bottom Board		05				
7	Turn Flask Over		06				
8	Dust-Place Board		18				
9	Place Riddle & Facing		08				
10	Shovel & Riddle Sand		15				
11	Shovel & Ram Sand		64				
12	Cut & Form Sprue		05				
13	Lift Cope		13				
14	Draw Pattern		12				
15	Set Strainer		12				
16	Replace Cope		14				
17	Remove Flask		10				
18	Place on Floor		15				
		3	06	3	14		
	TOTAL ITEMS					3	10
	ALLOWANCES Contingencies 38.5%					1	19
	NO PIECES 6 TOTAL TIME MINUTES					4	29
	AVE TIME PER PIECE .715 STD HOURS .012						

2nd observation

FIG. 1—THE TIME-STUDY CARD IS LOOSE-LEAF—THE FRONT OF THE CARD IS USED FOR GENERAL INFORMATION ABOUT THE JOB SUCH AS DESCRIPTION OF THE EQUIPMENT FIG. 2—DETAILS OF THE TIME REQUIRED FOR EACH ELEMENTARY DIVISION OF THE OPERATION ARE RECORDED ON THE BACK OF THE TIME-STUDY CARD

C P 27 1-19

TIME STUDY REGISTER

FROM NO B58 TO NO B76

DATE 1920	REGISTER NO	PART NUMBER	OPERATION	STD TIME HOURS	PIECE PRICE	TIME STUDY TAKEN BY
1-19	B-58	5D35	Mold-Set Cores-Pour Shake Out	.06		G. L. Lyman
1-19	B-59	5D33	" " " " " "	.06		"
1-19	B-60	5D32	" " " " " "	.06		"
1-20	B-61	1382-N	" " " " " "	.0[illegible]		"
1-21	B62	J6699	" " " " " "	.021		"
1-22	B63	37832	Mold-Pour-Shake Out	.036		"
1-29	B64	47482	" " " "	.0143		"
1-29	B65	45278	" " " "	.012		"

FIG. 3—AFTER THE TIME STUDY IS MADE A RECORD OF IT IS KEPT ON THE TIME-STUDY REGISTER—THE TIME-STUDY CARD CAN THEN BE LOCATED BY THE REGISTER NUMBER WHICH IS GIVEN IT

Time Study Underlies Bonus System

Production Department Determines Standard Time for Different Foundry Operations and Keeps a Record of the Amount of Each Kind of Stock on Hand and Being Consumed

BY H. E. DILLER

IN SOME few shops the proprietor of the foundry is also the manager, the whole molding and core-making force, besides being cupola tender and shipping clerk. Such an industrial organization has some advantage over the big company with its hundreds of employes, in that it has no need for scheduled system. However, as soon as a foundry employs more than one man, some form of production system is introduced. When the number of employes reaches the hundreds or possibly to the thousands, the difficulty of successfully directing the activities of all these workmen in their various activities is more and more complicated. In recent years the production department has become more important in the foundry. The comparatively new department has had many difficulties to overcome and much prejudice to meet in establishing its sphere in the foundry, but it has proved its essential value and now every large foundry has a force of men operating under the name of production department or performing the functions of such a division.

Production methods at the Saginaw Malleable Iron Co., largely are under direction of the production department of the General Motors Co. which has a staff of trained experts which applies the basic principles of production to machine shop, assembling department or foundry with equal facility. At times slight modifications in the standard forms will fit them for work in a particular department. In such cases the modifications is made but the essentials are kept as close as possible to the original standard form.

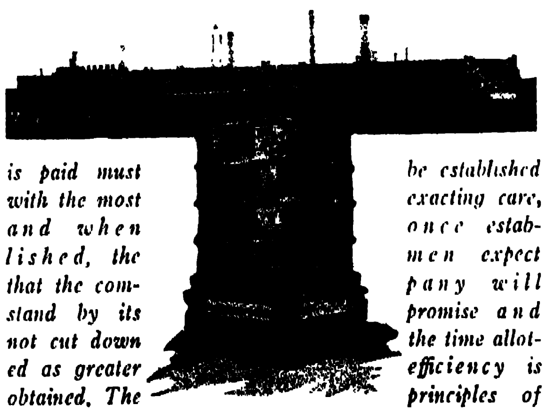
The work of the production department is split into two general divisions; the one handling materials and production control, and the other the standards or time-study department. This latter section determines the time which is necessary to make each new job which comes to the foundry. This is done by a time study in which the length of time for each operation is found and established. Time studies also are taken when any change is made on a pattern involving even a slight modification of the operation. The time studies serve as a basis for determining the bonus to be added to the hourly rate at which the workmen are paid. This hourly rate is determined by the rate being paid in the trade for day labor.

The molder is paid his hourly rate no matter how many molds he makes, but if he makes more than 75 per cent of the molds which the time-study department has determined is the standard rate for the particular pattern, he will receive a bonus. The amount of the bonus varies with each per cent of the established base up to 200 per cent. At 76 per cent the lowest bonus, which amounts to 1.6 per cent is paid. When the molder makes what has been determined should be a normal day's output, or 10 per cent standard time, he receives a bonus of 20 per cent. This amount is increased to 50 per cent when 125 per cent efficiency has been reached; while at 150 per cent efficiency, above which few molders go, an 80 per cent bonus is paid.

In setting the standard time, it is considered that a good workman will average 110 per cent or better, which brings him a bonus of 32 per cent. Therefore, the inducement is considered liberal enough to induce the workmen to strive

Time Study Principles

ABSOLUTE fairness on the part of both management and employe is essential for the success of any bonus system. The basis upon which the bonus



is paid must be established with the most exacting care, and when once established, the men expect that the company will stand by its promise and not cut down the time allotted as greater efficiency is obtained. The principles of time study are elucidated in the following excerpt taken from a circular written by E. K. Wennerlund, General Motors Co., for the direction of the production departments of the various branches of that company, including the Saginaw Malleable Iron Co. Mr. Wennerlund says:

The primary object in taking a time study of a shop operation is to arrive at a *standard time*, i. e. standard rate of production. This standard of production, when established, may be used as a basis for either of the following:

Payment of a bonus as a reward for efficient production.
Establishing a piece rate for the operation.
A check on present or proposed shop methods.

Standard time may be defined as the time required to perform a given operation, a group of operations, by the average competent workman, repeatedly over an extended period. Lost and waste time is eliminated from the standard time, except to the extent of providing for minor delays incident to the shop conditions.

The purposes aimed at in placing standard time on operations in the shop, and offering a bonus reward for production, are as follows:

To stimulate the workman to greater effort.
To reward him in proportion to that effort.
To furnish a standard for the measurement of the rate of production.
To measure the efficiency of the workmen, individually or in groups.

A time study should be taken by a specially trained investigator. He should have the full co-operation and support of the department foreman, while in the exercise of his duties. When preparing to take a time study, the investigator should ascertain that the equipment is in a first-class condition; that light and ventilation are satisfactory; also, that the material to be worked on is in good standard condition for the operation.

He will also investigate and record, as a result of motion study, the number and kind of motions necessary to perform the operation in the easiest manner and the shortest time. He should inform the workman fully what are the purposes of the investigation, and get him to conform his methods to the best shop practice.

for as large a bonus as possible. Of course, it is essential that an hourly base rate be established which is consistent with prevailing wages in the community. The Saginaw company has decided that there is nothing to be gained by maintaining a low hourly rate and then raising the standard time to make the total earnings attractive. It has been found that high hourly rates attract good producers. The management insists on a workman doing a fair day's work to remain in service.

Naturally, when the wages paid the molder depend on the time study it is necessary to use every precaution to see that a fair rate is set. The man who does this must be familiar with the work as well as with human nature. He must know how to divide the job into different operations and be able to determine whether the molder is trying to perform the operation normally. Such ability is only acquired by long practice. Therefore, only one man is employed to set the standard time rate.

When a time study is made, the results are put on the back of a time-study card as illustrated in Fig. 2. The figures in this illustration, as in all other illustrations in this article, are not given as actual but are assumed figures which are assigned merely to elucidate the working of the system. A division of the job is made into its different elementary operations, and the time for each operation is recorded in hundredths of a minute by use of a decimal stop watch. A second observation is made to compare with the record of the first. Should the time consumed by any elementary observation vary in the two trials, a third or even a fourth trial is made and the reason for the variation is determined. At times it is impossible to induce the molder to enter fairly into the spirit of the study. In such cases the investigator must be able to tell when false results are being obtained through lack of co-operation of the molder, and if the molder cannot be induced to give the time study a fair trial the investigator sets a time which he judges as fair. This occasion seldom arises, as the molders appreciate the system after they come to understand it and realizes its fairness. In case the second observation tallies closely in the time of all elementary operations, the individual results are not put on the card, but the total time is recorded. The time for the two trials is then averaged to secure the time to be allowed for the operation. In setting the allowed time the investigator must take into consideration an average good working condition for each operation.

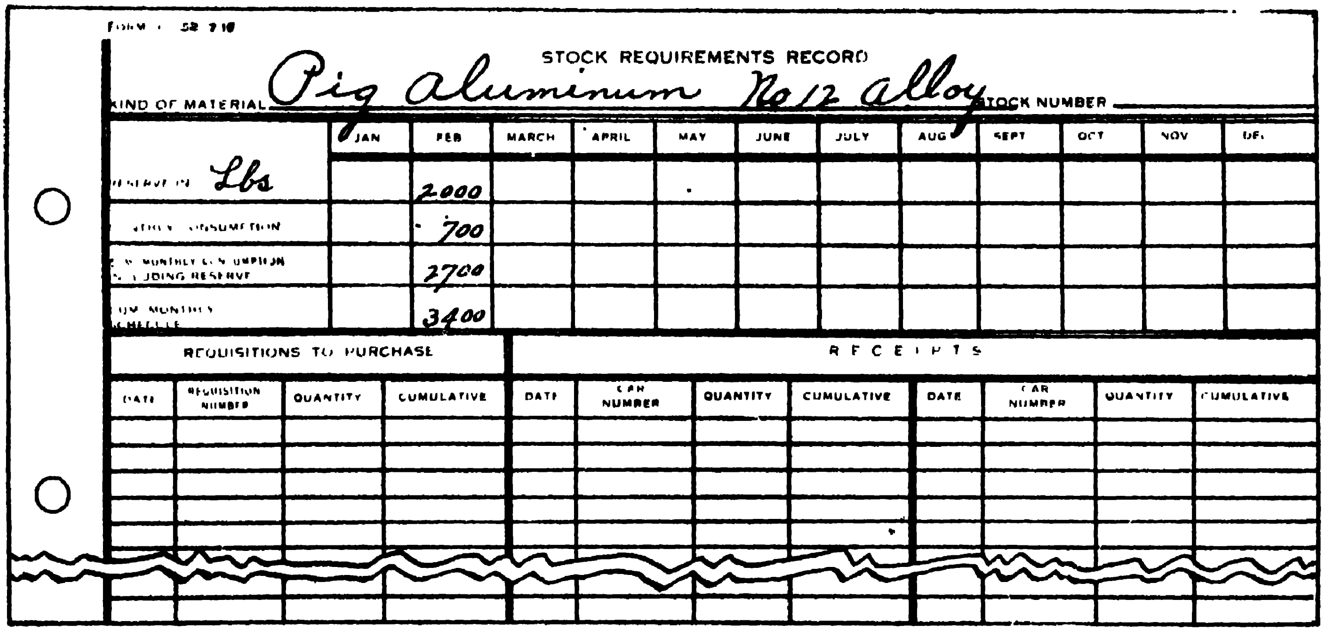
The elementary divisions on the time-study form show only the net time without any allowance for contingencies. The total of these items then shows the net time for the complete operation. It is thought essential to adhere to this practice so that the time study may be of value for future reference. However, certain allowances incident to the operation are made to have the established time represent the standard rate of production repeatedly over an extended period and to allow for unavoidable contingencies. Ten per cent is the average time allowed for contingencies. In addition to this, an extra allowance of 28½ per cent is allowed for pouring. The molder works nine hours a day and it is estimated that two hours of this time is consumed in pouring the molds and shaking out castings. A secondary allowance sometimes is considered to take care of extraordinary conditions not incidental to the operation.

The sums of all items are averaged and placed in the line marked *Total Items*, Fig. 2. Below this figure is the time allowed for contingencies. These two are added together to make the total time in minutes, which is carried out to the hundredth of a minute. The number of pieces in a flask, the average time per piece, and the standard hours also are marked at the foot of the page, as illustrated in Fig. 2. The average time in minutes is obtained by dividing the total time by the number of pieces in a mold. The standard number of hours is secured by dividing the average time per piece by 60, which converts the average time into decimals of an hour.

When this work is finished, the management has, on the back of the time card, a record which can be referred to at any time. On the front of the card is kept a detailed account of the job. As shown in Fig. 1, this includes the date the time study was made, the type of equipment, a complete description of the equipment, a list of special fixtures, the kind of operation, the number of employes working on the job, standard production per hour, etc.

All time studies are numbered serially and registered on a form known as the *Time Study Register*, Fig. 3. This register number then appears on all job tickets or credits where the standard time is used. Any change in standard time requires that a new time-study form be made, with a new register number, stating reasons for the change.

These register numbers may be prefixed by a letter, in which case the numbers run serially after each prefix.


FORM 52 710

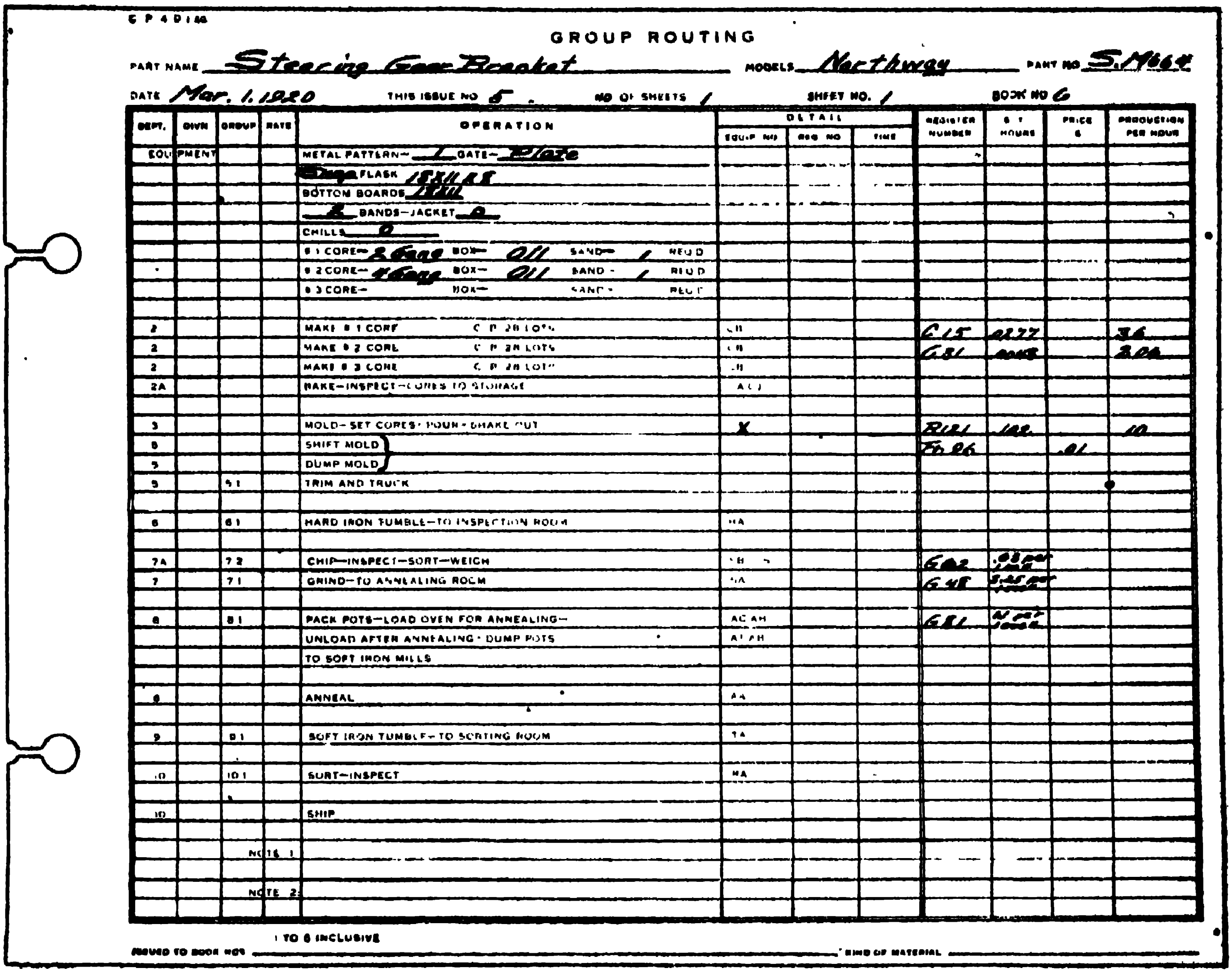
STOCK REQUIREMENTS RECORD

KIND OF MATERIAL Pig aluminum No 12 alloy STOCK NUMBER

	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
RESERVE IN Lbs		2000										
STOCK CONSUMPTION		700										
MONTHLY CONSUMPTION INCLUDING RESERVE		2700										
MONTHLY SCHEDULE		3400										

REQUISITIONS TO PURCHASE				RECEIPTS							
DATE	REQUISITION NUMBER	QUANTITY	CUMULATIVE	DATE	CAR NUMBER	QUANTITY	CUMULATIVE	DATE	CAR NUMBER	QUANTITY	CUMULATIVE

FIG. 1—CLOSE ACCOUNT OF THE STOCK ON HAND AS WELL AS THE AMOUNT BEING CONSUMED IS KEPT ON LOOSE-LEAF FORMS



C P 4 D 146

GROUP ROUTING

PART NAME Steering Gear Bracket MODELS Northway PART NO S.M664

DATE Mar. 1. 1920 THIS ISSUE NO 5 NO OF SHEETS 1 SHEET NO. 1 BOOK NO 6

DEPT.	DIVN	GROUP	RATE	OPERATION	DETAIL EQUIP NO	DETAIL REG NO	DETAIL TIME	REGISTER NUMBER	S T HOURS	PRICE $	PRODUCTION PER HOUR
EQUIPMENT				METAL PATTERN—1 GATE—Plate							
				Snap FLASK 18X11X8							
				BOTTOM BOARDS 18X11							
				2 BANDS—JACKET 0							
				CHILLS 0							
				# 1 CORE—2 Gang BOX—011 SAND—1 REQ'D							
				# 2 CORE—4 Gang BOX—011 SAND—1 REQ'D							
				# 3 CORE— BOX— SAND— REQ'D							
2				MAKE # 1 CORE C P 28 LOTS	CH			G15	.0277		36
2				MAKE # 2 CORE C P 28 LOTS	CH			G31	.0048		208
2				MAKE # 3 CORE C P 28 LOTS	CH						
2A				BAKE—INSPECT—CORES TO STORAGE	ACJ						
3				MOLD—SET CORES—POUR—SHAKE OUT	X			R121	.100		10
5				SHIFT MOLD				Fo 26		.01	
5				DUMP MOLD							
5		51		TRIM AND TRUCK							
6		61		HARD IRON TUMBLE—TO INSPECTION ROOM	HA						
7A		72		CHIP—INSPECT—SORT—WEIGH	SB			G82	.03 per lb		
7		71		GRIND—TO ANNEALING ROOM	SA			G48	3.25 per 100		
8		81		PACK POTS—LOAD OVEN FOR ANNEALING—	AC AH			G81	.41 per 100		
				UNLOAD AFTER ANNEALING—DUMP POTS	AC AH						
				TO SOFT IRON MILLS							
8				ANNEAL	AA						
9		91		SOFT IRON TUMBLE—TO SORTING ROOM	TA						
10		101		SORT—INSPECT	HA						
10				SHIP							
		NOTE 1									
		NOTE 2:									

1 TO 8 INCLUSIVE

ISSUED TO BOOK NOS KIND OF MATERIAL

FIG. 5—THE STANDARD TIME ALLOWED FOR THE DIFFERENT OPERATIONS IS NOTED ON THE GROUP ROUTING SHEET—A COLUMN ON THIS SHEET IS ALSO RESERVED FOR RECORDING THE VARIOUS REGISTER NUMBERS FOR THE SEVERAL OPERATIONS

For example, under the group bonus plan a number of minor operations are combined into one group operation, and the standard time for the latter is the total time in man-hours of its minor operations. In this case it will be found convenient to designate minor operation time study numbers with the prefix *D*, and group operations by prefix *G*.

For group operation standard times, a separate time study from Figs. 1 and 2 is filled out showing register number, name of operation, and standard time of each minor operation. If an extra allowance of time is necessary it should be included, not for the minor operation but for the group operation; thus, showing basic standard time only, for the minor operations. This facilitates the rearrangement of minor operations from one group to another on the routing sheet, without referring to the time study for each operation.

Before the standard time becomes official, the manuscript is audited carefully in the standard department office. All additions are checked and reference is made to time studies covering similar operations, so that no mistake is made.

The standard time system with a bonus reward, is considered to be essentially a day-work plan as distinguished from the piece-rate system. Each employe receives a fixed hourly rate, and an additional bonus is paid, dependent on the speed of production. By dividing the cumulative standard hours, for a period, by the corresponding actual elapsed hours, the relative efficiency of production is obtained. The per cent bonus to be paid in addition to the base wage for the elapsed hours is obtained from a bonus table, which has been standardized. When computing the efficiency of groups of employes, man hours, both standard and actual, always are used. At or below an efficiency of 75 per cent, the employe is automatically on a flat day rate, zero bonus being earned.

To make the standard time effective as a wage plan, it is deemed requisite that production be speeded up to where the employe can earn a substantial bonus, amounting to 20 per cent or better, in addition to the base wage. It is the duty of the standards department through its shop investigators, to see to it that a satisfactory degree of efficiency is maintained on each operation. Where the efficiency shows low, the first step is to determine the reason. Any one of the following conditions may exist:

The standard time may be too low for the average conditions.
The operator may be incompetent.
He may lack interest.
A temporary poor quality of material, or a bad condition of equipments, ventilation, or room temperature may obtain.

If the standard time is found to be too low, it is remedied by taking a new time study. Where the other conditions exist, the full co-operation of the department foreman and the factory management is secured. The standards department is required to watch the case until the adverse conditions have been rectified. Generally speaking, it has been found that if the standard time is fair, and surrounding conditions near normal, the workman will do his utmost to maintain a high degree of efficiency, he is convinced that the expected rate of production is attainable.

Since it should be the policy to allow a basic standard time to stand permanently when once established, unless

there is a change in equipment, materials, or methods, care is exercised that standard time is not set until it is correct. Unless the workman can feel confident that the time will not be changed under existing conditions, he is not likely to put forth his best efforts. When new methods or equipment are introduced, a new time study based on the changed conditions is justified. Where the workman makes a suggestion resulting in improved methods or equipment, he is suitably rewarded by the management; for it is estimated that to allow the standard time to stand under the improved conditions will cost a great deal more cumulatively than would a liberal cash reward paid when adopting the suggestion for saving time.

The bonus is computed for each pay period. It is pointed out to the workman that if he attains a high efficiency for part of a pay period, and a lower efficiency down to 75 per cent, for a portion of the period, that he does not lose the bonus which has been earned previously. It may lower his average efficiency, and hence the percentage of bonus, but this percentage is computed over a longer period; so that bonus once earned within these limits, is not subsequently lost.

Application of the standard time system is shown in the form illustrated in Fig. 5. This is the group routing for a steering gear bracket. It gives a description of the equipment required, the number and kind of cores, and a list of the different operations such as, make core, mold set cores, pour shakeout, shift mold, dump mold, chip, inspect, sort, weigh, etc. Then in two columns toward the right the register numbers are given and the standard time hours for the different operations are noted. The estimated production per hour is indicated in the last column.

Another function of the production department is to keep the management and the purchasing department informed as to the state of stock on hand. The management decides how long ahead the foundry should be covered for the different materials and the purchasing department makes the contracts. However, they secure their data from which they derive the amount to be contracted from the production department who must keep continually informed on the state of the reserve of all materials. In case the amount of any material on hand is above or below the amount decided on as the proper reserve the purchasing department must be notified. To have this information constantly available a record is kept on the form shown in Fig. 4, headed *Stock Requirement Record*. The name of the material and the stock number are placed on the first line. The table immediately under this is so arranged that a year's record may be kept of the reserve in pounds, tons, gallons or whatever it may be; of the monthly consumption; of the cumulative monthly consumption including reserve obtained by adding the two; and of the cumulative monthly schedule. Below this are two tables for keeping a record of the requisitions and the receipts. Other forms are necessary for reporting the daily consumption and summing up the monthly total consumption, but this form tells the story at a glance of how much stock is on hand and how much is due on orders together with the consumption.

Melting Steel and Iron in the Cupola

Question:—We have considerable cast scrap with machine steel fast to it. Would it be any disadvantage to our melt to put say 10 per cent of this steel and iron in the cupola? We make machinery castings and use 2/3 scrap and 1/3 pig iron.

Answer:—Instead of being a disadvantage the addition of steel to the cupola charge in amounts varying from 5 to 40 per cent now is recognized as a distinct advantage. It does not matter whether it is added in the shape you mention or whether it is added as a separate and distinct part of the charge, as boiler punchings, clippings or any other form of steel scrap.

The only point you have to watch is the silicon content. The amount of silicon in soft steel scrap is practically negligible, and cast iron loses approximately 0.25 per cent when melted. Therefore when making up the charge, it will be necessary to allow for the absence of silicon in the steel and the cupola loss in the iron.

At present you are using 33 1/3 pig iron and 66 2/3 scrap which probably gives you iron about as hard as you care to machine in thin sections. The substitution of part of the scrap charge with steel would make this still harder and therefore it will be necessary for you either to use a little more pig iron, to use the same relative proportions of pig iron but of a little higher silicon content, or to use the same relative proportions of pig iron and scrap as at present and in addition about 10 pounds of 50 per cent ferrosilicon to each ton of iron.

Defective castings, those having blow holes and hard spots, are frequently attributed by amateurs to steel in the charge when in reality they are due either to poor molding or furnace practice. To secure clean, solid castings, the iron must be melted hot and this is particularly true when the charge is partly made up of steel. By *hot* is not merely meant hot enough to run but what the foundryman calls *smoking hot*.

Manganese Hardens Welds

Successful results obtained from a considerable number of welds made by several large steel mills have shown, according to a statement by the Metal & Thermit Corp., New York City, that the life of wobblers on pinions, rolls and large shafts which have been repaired by thermit welding, after previously having been worn away or broken, can be materially prolonged by the addition of 3 per cent pure manganese to the railroad thermit, in addition to the 1 per cent of pure manganese already in the product. This will give a hard wearing surface. Wobblers should be thoroughly heated to about 1400 degrees Fahr. before welding; otherwise no amalgamation of the two metals will be obtained.

Build Mexican Plants

Arrangements have been made by the Oil Well Supply Co., Pittsburgh, and the Tampico Foundry, Machine & Supply Co., to build plants upon La Isleta, an island which has a large frontage on the Tuxpam river, near Tampico, Mexico These corporations have purchased land upon the island on which they will locate their plants The Oil Well Supply Co. will expend about $400,000 in the construction of machine shops, warehouses, etc, while the Tampico Foundry, Machine & Supply Co., besides moving its foundry and machine shops to the new location will expend about $100,000 in new equipment.

Claims Process to Make Steel from Ore

According to a report from Brussels, the Belgian ironworks of the Ougree-Marihaye have recently acquired, from a French engineer, for the sum of 1,000,000 francs the patent for all countries for prod[illegible] steel direct from iron ore, the [illegible]-furnace coke being replaced by [illegible]nary pulverized coal. Experiments which have been made by the new process are stated to have given full satisfaction.

Organized for the purpose of making malleable castings, the Ashland Malleable Co., Ashland, O., expects to have a foundry built before Jan. 1, 1921. It is capitalized for $150,000 and will be in the market for all sorts of foundry equipment. J. H. Firestone, Spencer, O., is president; Samuel Miller, E. M. Armstrong and W. L. Rybolt, all of Ashland, are vice president, secretary and treasurer, respectively.

How Spur Gear Patterns Are Made-II

Nearly Every Type and Style of Spur Gear is Described and Illustrated Together with Practical Hints and Advice on the Construction of the Patterns

BY JOSEPH HORNER

NUMEROUS variations in the sectional forms of wheel rims, bodies, arms, and bosses, control the methods of pattern construction. The group of sections in Fig. 14 illustrates shapes that are in general use. *A* is not employed so much in pattern work as some other forms. It is chiefly confined to small gears, subject to moderate stresses, the teeth of which are cut by machines. In that case the rim is cast solid and the casting, often of steel is molded from a metal pattern. Sometimes the blanks are forgings. No large wheels are made with elliptical arms. Many small gears; those of medium dimensions, and all pinions are either solid-plated, or when the shaft occupies a large proportion of the diameter, are solid chunks.

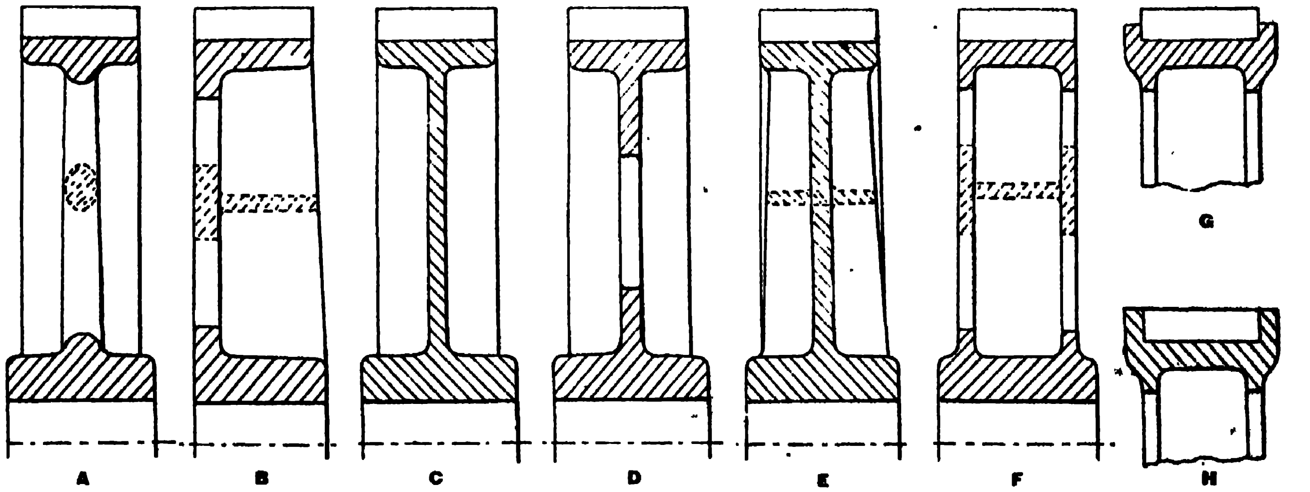


FIG. 14—A GROUP OF SECTIONS SHOWING SOME OF THE STYLES OF GEARS IN GENERAL USE—*G* AND *H* ILLUSTRATE SHROUDED WHEELS

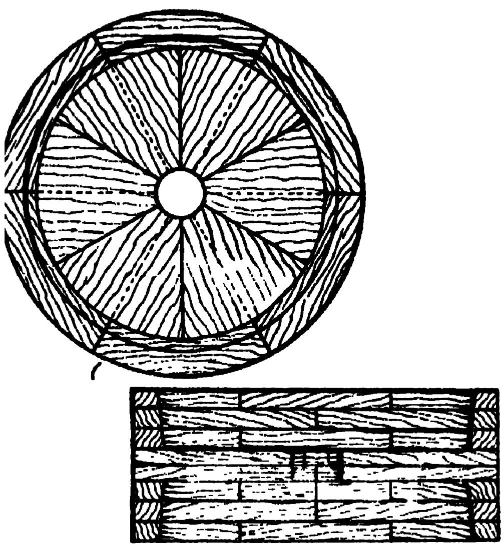
The larger gears are usually made to the sections of *B* or *C*. *B* has arms of *T* section; *C* has a plated center which is often lightened out as at *D*, with circular holes. Vertical ribs may also stiffen the arms, as at *E*, which is an alternative to placing the ribs on the side, as at *B*. *F*, with arms of the *H* section is almost exclusively confined to machine-molded gears, where the arms are made with dry-sand cores. *G* shows how teeth are strengthened by capping or shrouding to the pitch line, the mating gear being similarly treated. *H* illustrates full-shrouding, in which case the mating wheel is not capped at all. The patternmaker can see almost at a glance how these varied shapes introduce diversities in molding, and in pattern construction. Fittings for clutches and bosses are frequently included while often, castings of two gears of different sizes and shapes are cast in one.

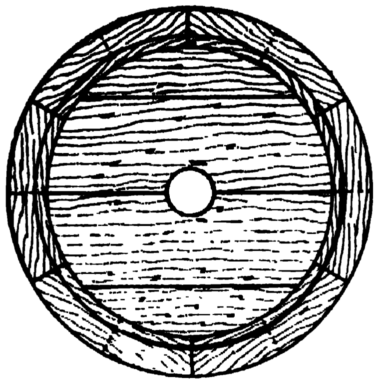
Fig. 15 shows a plan, and a section through a plated pattern, suitable for any diameter where a plated center is employed. In no case may a plate be made of solid stuff. If of large diameter, it must be built up with segment-sectors, as in Fig. 15, or with open joints, Fig. 16, if of moderate or small dimensions. The built-up plate in Fig. 15 includes at least two thicknesses, and preferably three. In such centers the bosses are fitted with central studs in order that stock bosses of different sizes can be interchanged. A central hole of one standard size, as say, 1½ inches, is made in all wheel patterns of this class. The rim is built in segments on the plate, Figs. 15 and 16. The plate in Fig. 16 with open joints will not shrink and cause the wheel to become elliptical, but it is not quite so rigid as the built-up plate in Fig. 15. Dowels may be fitted in the joints in the larger diameters to prevent the warping and lapping of adjacent edges.

A large pattern with a plated center is shown in Fig. 17 having half-shrouding to the pitch lines, with allowance for turning. It shows also how glued segments are reinforced with wooden pegs in the plated center; in the rim segments and in the shroudings. In building this up the actual rim segments terminate in the planes, *A*, *A*, with the ends of the teeth which are attached to the body of the pattern. The shroudings are glued-up separately, and the lower one has to be left loose for delivery. It is fitted with a shouldered cheek, as shown, which self-centers it. The upper shroud is also left loose, being fitted with dowells and lifts with the cope. The mold has to be made in a three-part box. It is desirable to leave the top shroud loose, in order both to withdraw it from the cope instead of lifting the mold off it, and to leave the upper ends of the teeth clear for ramming the sand.

Fig. 18 shows a small plated gear, wholly shrouded, and having the central bosses and the prints fitted with studs. The shroudings of small diameter are not built in segments, but are turned from solid mahogany. This is only suitable for patterns not exceeding 6 or 7 inches in diameter. Both shrouds are dowelled to the rim. The plate must have open joints.

Figs. 19 and 20 illustrate pinions built up with radial sectors. Fig. 19 is double, and full-shrouded; the shrouds are fitted loosely to the pattern body





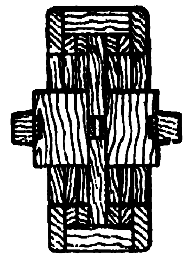
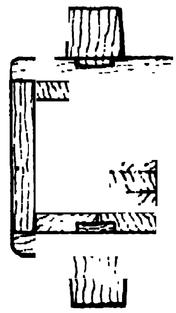


FIG. 15



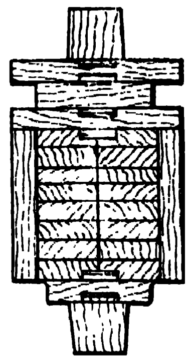


FIG. 19

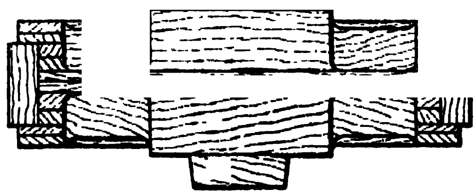


FIG. 21

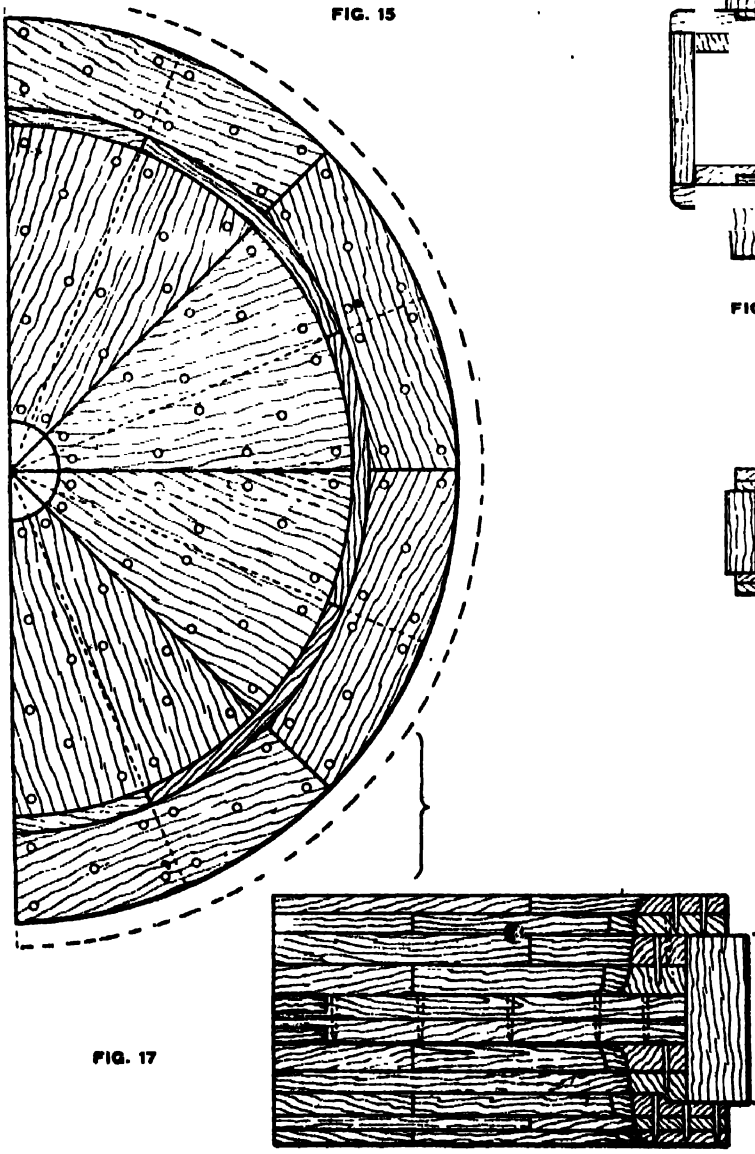


FIG. 17

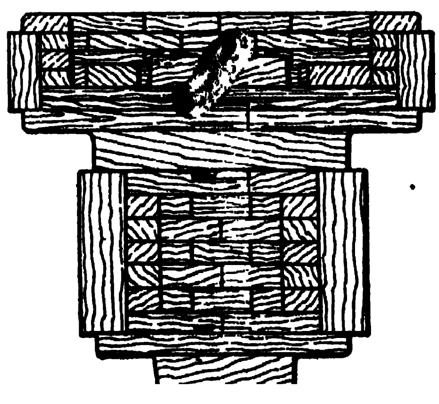


FIG. 22

FIG. 15—PLAN AND SECTION THROUGH A PLATED JOINTS FIG. 16—SAME WITH OPEN SHROUDING TO THE PITCH LINE, ALSO ALLOWANCE FOR TURNING FIG. 17—A LARGE PATTERN WITH A PLATED CENTER HAVING HALF SHROUDING FIG. 18—SHOWS A SMALL PLATED GEAR WHOLLY SHROUDED FIGS. 19 AND 20 ILLUSTRATE PINIONS BUILT UP WITH RADIAL SECTORS FIG. 21—A PLATED PATTERN WITH VERTICAL RIBS AND HALF SHROUDED FIG. 22—A CLUTCH WHEEL AND PINION EACH HALF SHROUDED

with central studs, and the prints similarly attached. Fig. 20 is full-shrouded at one end only, fitted to a sliding clutch boss, the pinion being one of those that are slid into and out of engagement with their wheels. A boss on the other end serves to terminate its longitudinal position on the shaft. All parts are attached with studs, and all except the core prints are left loose.

Fig. 21 is a plated pattern, with vertical ribs and teeth half-shrouded. The plate is built of radial sectors and each of the shroudings with two courses of sweeps; both are dowelled to the rim. The vertical ribs are attached to the bosses, to be left loose in the top. They may be fast in the bottom, or left loose.

Fig. 22 illustrates a combination of a clutch wheel and a pinion, each half shrouded to the pitch line to be cast together. All attachments are with central studs and no parts are fastened. Clutch jaws and a core print are fitted in the wheel The shroudings are turned in solid stuff. The pinion is built-up with ring segments, making it a hollow pattern, instead of solid, as in Figs. 19 and 20.

Fitting the Arms

Gear patterns having arms are fitted in various ways. Fig. 23 shows how four arms are locked; Fig. 24, six arms; and Fig. 25 is a perspective view of the cutting of each strip. Arms must first be prepared and sunk into the rim during the building-up if they occupy the center of the rim, or subsequently to the building, if they occupy one side as in Fig. 26. Care must be taken with large wheels having light rims not to distort them by driving the arms tightly into the recesses prepared for them. They must just go in with a light hand pressure. Vertical ribs can be abutted against the bosses, or let into shallow recesses cut in the boss, or be made as a frame as in Fig. 28, and the boss be put in sectors.

Since wheel teeth of wood patterns are liable with long service to become worn, roughened-up, or displaced on their rims; and segments are subject to shrink or swell, and so produce slightly lapping joints, an excellent method is to use cast-iron rims with teeth and fit the arms in wood. This insures permanence of form of the most important portion of the pattern; materially reduces the weight to be handled; allows of making alterations in the arms if required; permits of cutting the teeth accurately in a machine; and allows the wheel teeth to be drawn through an iron stripping plate if necessary.

Fig. 29 shows arms and ribs of wood fitted with an iron rim. The top ribs,

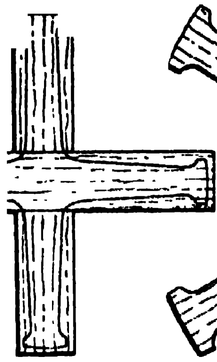


FIG. 23

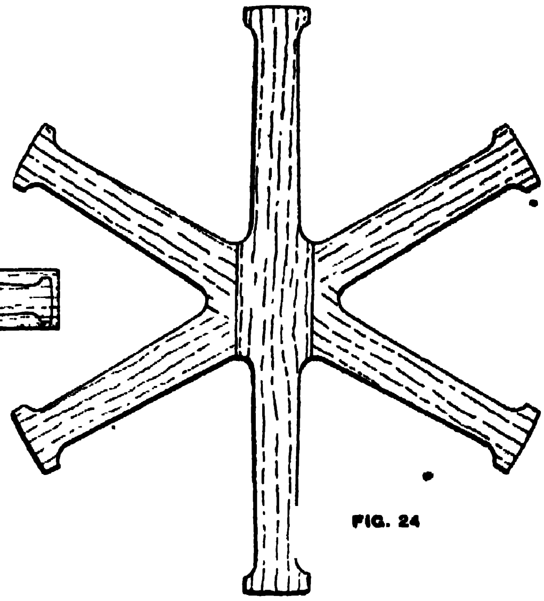


FIG. 24

FIGS. 23 AND 24 ILLUSTRATE METHODS OF MAKING THE JOINT AT THE CENTER OF THE ARMS

fitting in the top boss are loosely dowelled on the arms. The lower ribs are screwed permanently to the arms. The arms are not fastened to the rim in any way, but the fitting of the arms and bottom ribs within the shouldered section enables the molder to locate them correctly. Fig. 30 illustrates arms of T section. The flat arms and the vertical ribs are screwed together permanently, and merely laid within the rim. The molder levels them. Fig. 31 is a wheel with a plated center. This is fitted into the rim with a shoulder to center it in the absence of ribs. If ribs were fitted, the same method as that in Fig. 29 would be adopted.

Familiar Types of Wheels

Succeeding Figs. illustrate combinations of wheels that are common. Fig. 32 is the pattern for a spur wheel and pinion to be cast together; the pinion

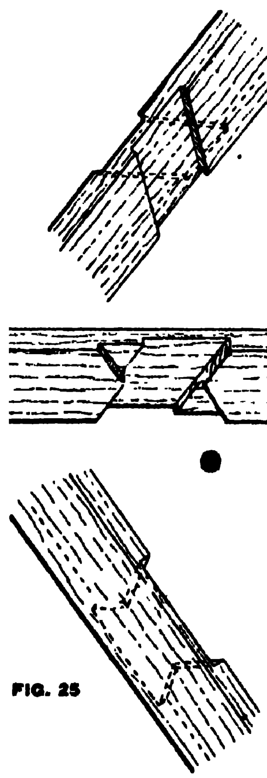


FIG. 25

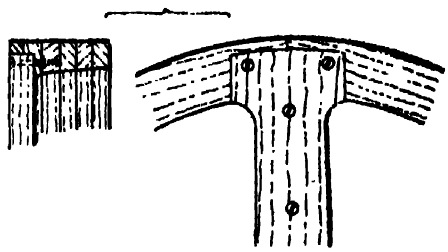


FIG. 26

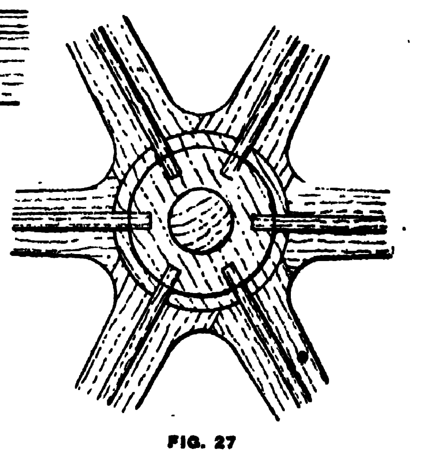
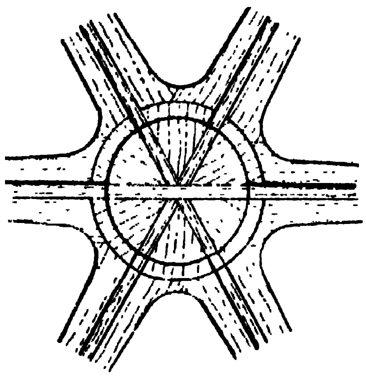


FIG. 27

FIG. 25—HOW EACH STRIP IS CUT TO JOIN AT ARM CENTER FIGS. 26 AND 27—METHOD OF ATTACHING THE ARMS AND RIBS TO THE RIM AND HUB



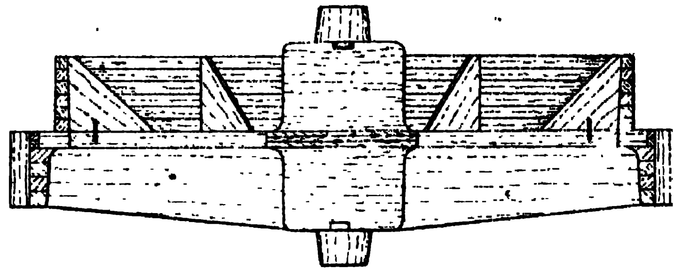


FIG. 33

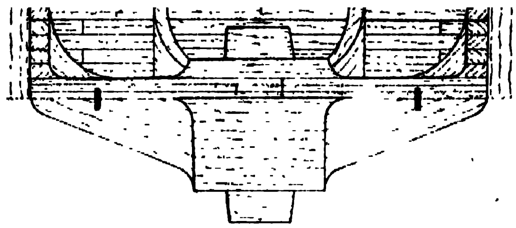


FIG. 29

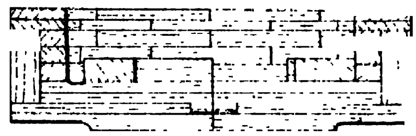


FIG. 31

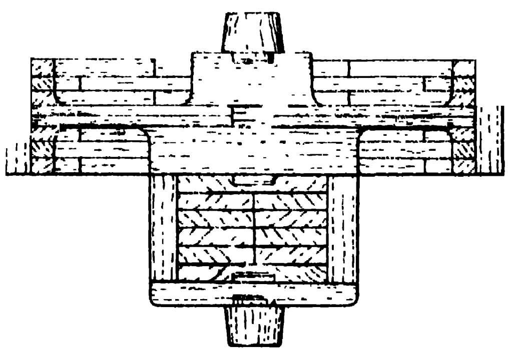
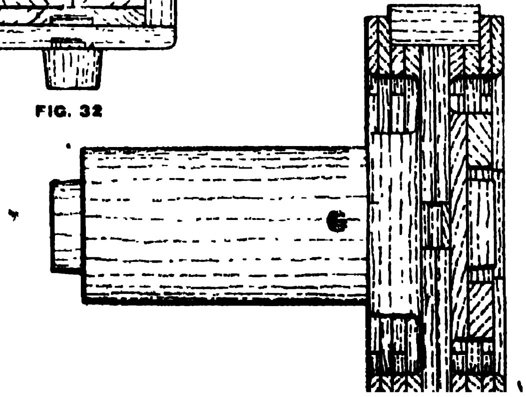


FIG. 32



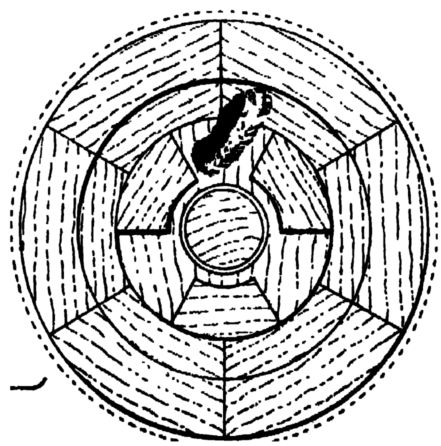


FIG. 36

FIG. 28—ATTACHING ARMS TO HUB FIGS. 29, 30, 31—ATTACHING WOODEN ARMS AND HUBS TO CAST-IRON RIM PATTERNS OF VARIOUS DESIGNS FIG. 32—A SPUR WHEEL AND PINION TO BE CAST AS A UNIT FIG. 33—A SPUR WHEEL PROVIDED WITH A BRAKE BAND FIG. 34—A SPUR GEAR WITH HUB AND ARMS ON THE OUTSIDE FIG. 35—WHEEL, DOUBLE SHROUDED, TO BE CAST WITH A HALF SHROUDED PINION FIG. 36—HALF SHROUDED WHEEL WITH CLUTCH JAWS ON ONE SIDE

being wholly shrouded to gear with the barrel wheel of a crane, remaining permanently in mesh. Each is built up with segments, and the parts all fit mutually with center studs and are left loose. Pinions and wheels of different dimensions can be readily substituted. Fig. 33 shows the rim for a band brake to be cast on, its wheel. It is dowelled on the back of the wheel rim, and is stiffened with brackets screwed to the ring pattern, to come away with it in the cope. Fig. 34 is an example of a wheel, the interior of which is occupied on its shaft with the boss of another gear, which entails making the necessary length of wheel boss to stand out at the back. This, with its arms is dowelled to the plated center. The interior of the rim in the absence of arms is stiffened with brackets.

Fig. 35 shows a wheel, double-shrouded to the tooth points, to be cast with a pinion half-shrouded. The wheel and its shroudings is built-up with segments, and has clutch jaws fitted. The pinion is cut from a solid block, with the grain running axially, and its shroudings are solid. The central core is so large that no top print is included. Fig. 36 is a half-shrouded wheel with clutch jaws on one side, and a long boss on the other. The shroudings are dowelled to the wheel rim. Top and bottom prints are fitted for the central core. In all these examples the patterns are drawn as they are molded. These cover all typical cases of spur gear work.

How and Why in Brass Founding

By Charles Vickers

Match Plate Materials

We desire to obtain mixtures suitable for making match plates and follow boards.

A mixture extensively used for pattern plates, match plates and oddsides follows: Portland cement, 2 parts; plaster of paris, 1 part; sharp sand, 1 part. A different mixture that is used for more permanent work follows: Asphalt, 74 pounds; plaster of paris, 24 pounds; plumbago, 2 pounds.

For oil sand matches, various mixtures are in use. The following is good: Finely sifted gangway sand, 89 parts; fine iron borings or turnings, 1 part; litharge, 3 parts. Mix dry and add sufficient linseed oil to dampen the mass; a little water also may be added.

For metal pattern plates, an alloy of aluminum, 93 per cent; copper, 7 per cent, is suitable, sometimes antimony or bismuth is added in small percentages to counteract the shrinkage. A low melting white metal for pattern consists of the following: Tin, 55 per cent; zinc, 44 per cent; bismuth, 1 part.

Facing Sand Mixtures

We desire to obtain a facing-sand formula for use in molds for bronze gears and worm wheels weighing from 60 to 125 pounds each. We have been making these castings in green sand, but have found the sand teeth of the mold are cut away by the molten metal.

The following is an excellent facing for all brass castings of the weight mentioned. The sands should be dry before they are mixed. Take new, fine molding sand, 10 parts; fine silica sand, 5 parts; ground clay, 1 part. For green sand work, the mixed dry sands should be dampened with water only, and should be ground together in a mill. For dry sand work, mix the dry sands with molasses water, or with glue water, and spray the molds well with molasses water after the patterns have been withdrawn and the mold has been finished. Afterwards, bake the molds in an oven, or skin dry them with a gasoline torch, or other source of heat.

Bronze worm wheels generally are made in chills, not in sand, as the chill produces a much finer grained metal than the sand mold. Both cast-iron molds and carbon molds are used. Worm wheels with the teeth cast in are made in metal dies, which are handled by machines. Perfect castings, true to size, with a minimum of finish are made thus.

Melting Brass in an Oil-Fired Furnace

In melting brass in an oil-fired furnace we have experienced difficulty from porosity in the castings. The holes are not seen until after the castings are machined. Can you advise us what to do to avoid this difficulty?

This difficulty may be caused by melting too rapidly and it will be advisable to try a less oxidizing flame on a few heats. The air supply can be reduced, or the oil supply can be increased according to circumstances. At the same time it will be well to use a molten cover on the brass, such for instance as green bottle glass.

The glass will melt and cover the surface of the brass that is molten in the crucible, and thus keep the furnace gases from the metal. If the gas is unable to get in contact with the metal it cannot be absorbed, and if no gas is absorbed, the castings will be solid.

Some Causes for Defects in Aluminum

We are sending for examination a sample aluminum casting which in service forms the base or body for an electric cleaner. You will note the casting is pitted and we wish to learn if this is caused by hard cores, some foreign substance in the metal, or is it due to the heavy section of the defective part? The alloy we use is regular No. 12. It is being poured at a temperature of 1375 to 1425 degrees Fahr. The aluminum is melted in an iron pot and is poured with a small hand ladle. A flux of sal ammoniac is used on the aluminum. The castings are molded on machines; the sand is regular aluminum molding sand. The face of the casting is made in the drag as the construction of the casting makes it impossible to cast it otherwise. Any information you may be able to give us will be appreciated.

An examination of the casting shows the following defects: (1) sand holes from the mold; (2) intercrystalline shrinkage; (3) cracking; (4) abraded core.

The sand holes are caused by breaking the mold when it was closed. The holes on the extreme ends of the suction part are due to this cause. The casting is awkwardly constructed at this point owing to the projecting lug. It will pay to consider carefully the feasibility of changing the pattern at this part; either carrying the lug in a core, or changing the contour of the pattern. If no change is considered possible, a heavy production loss must be figured as part of the cost of adhering to this particular shape. Out of every hundred castings made, a cer-

ain percentage will be defective because of crushing the sand when closing. It is no reflection on the molding that these sand holes are found at this point.

The second defect is intercrystalline shrinkage. This shrinkage is peculiar to aluminum alloys. Its effect is to produce the angular depressions scattered over the surface of the casting and it is caused by the separation of the rich copper-aluminum eutectic from the crystalline part of the alloy. The eutectic is the most fluid part of the alloy. In pouring a mold if the gate is attached to a thin section, a choking effect is produced as a result of which the less fluid portion of the alloy is strained out. The more fluid metal fills out the more remote parts of the mold, while the less fluid lodges in the parts adjacent to the gate and when the alloy solidifies, as the eutectic part of the less fluid metal has been removed to a considerable extent, there is nothing to fill the voids between the crystals after the latter have formed. The result is the formation of angular shaped depressions on the surfaces of the casting. These depressions, it will be noted, resemble the copper-aluminum eutectic as shown in photomicrographs of the alloy.

The difficulty can be remedied by a better distribution of the gates to fill all parts of the casting, or mold about the same time, thus avoiding the flow in the alloy. One of the most satisfactory ways of running aluminum castings is through drop gates the size of a lead pencil, distributed uniformly over the mold shape. If possible, this would cure two troubles, the angular cavaties and the cracking. How to get this more uniform distribution of the metal throughout the mold is a problem to which it will pay to devote much time and thought.

The third difficulty of the casting is cracking. This is caused by pouring the molds at too high a temperature. No doubt, the alloy must be very fluid to fill the casting from one gate. If the temperature of the aluminum when poured exceeds 1300 degrees Fahr., the percentage of cracked castings will increase with the temperature. At 1400 degrees and over, the cracking losses will be high. To run the molds with metal under 1300 degrees temperature requires a rapid filling, for this light section, and brings up once more the problem of a better adjustment of the gates.

The fourth fault found, namely abraded cores is easily remedied. If the cores are too soft externally to able them to be handled without crumbling, they should be sprayed before being dried with some glutinous binder such as molasses water or glue water. This will harden the surface to permit handling the cores without breaking them.

Flour Facing for Molds

We would like to learn what material is best to use as a coating for molds for brass castings. In making iron castings we use graphite mixtures which are applied to the mold in order to obtain a smooth, clean casting. We want to use in the case of brass in order to obtain castings, clean sand and dirt, and of the natural color of the brass.

In making molds for the reception of brass or bronze, the weight of the casting and the character of the alloy determine what coating or facing shall be applied to the mold. The majority of brass castings are cast in green-sand molds which are coated with ordinary flour. This is dusted on the mold through a cloth bag. If a very nice casting is wanted the flour is dusted on the mold twice, and after each application it is blown off with a bellows. This coating of flour causes the sand to *peel* from the brass casting. If the brass is composed of metals clean and free from iron, a clean, orange-colored casting is obtained. Iron in the alloy makes the casting black when it is taken from the sand. Phosphorus, also, makes dark colored castings. Massive bronze castings usually are coated with a greenish scale if the molds are not coated. They rarely possess the orange color. Therefore, it is usual to coat such molds with graphite, the same as in the case of iron. The graphite prevents the brass from sinting into the mold surface, producing a rough casting. Molds for heavy phosphor-bronze castings should be coated with liquid graphite, then dried before they are poured. This insures smooth castings.

Sulphur and Brass

Will you please advise us what action coke containing 2 per cent sulphur will have on brass or bronze melted in a No. 70 crucible? The furnaces are the pit type and the sulphur coke is used as fuel. Also can you offer suggestions for counteracting the effects of the sulphur?

Sulphur has the effect of producing spongy castings. This is because it reacts with oxygen or oxides to form a gas that is soluble in copper alloys. This gas simply aerates the metal, operating along the same lines as yeast in dough. To use a high-sulphur fuel means that greater care in melting is necessary to get solid castings, for if the metal is not protected from sulphur, or the gases formed in the furnace by burning sulphur, it will absorb the same, and retaining it when solid produce castings filled with holes.

A little calcium chloride placed in the bottom of the crucible has been found useful in preventing trouble when high-sulphur fuels are being used. The use of some cover on the metal also is advisable. Glass is often used, as it melts and makes a tight cover over the metal. If no difficulty is experienced with spongy castings, continue with the scheme of careful melting, and possibly no difficulty will be experienced. Sulphur alone, minus oxygen does not produce spongy castings; it has been added to the alloy 88-10-2 with the result the metal appeared to be rendered more dense. However, it darkens the skin of the castings and is likely to produce spongy castings with great ease. Therefore it is better to keep the sulphur as low as possible when melting copper or its alloys.

Manganese Bronze Formula

We would like to obtain your advice in regard to the best formula to use for making manganese bronze, as well as instruction for making this alloy. Please inform us if scrap metals can be used, and what amount of manganese should be added to the new metals.

Regarding the best formula for manganese bronze and the best method of making the alloy, there are as many opinions as there are manufacturers of this metal, each one believes he has the best method until he falls down and contemplates some big loss, then is not so sure about the matter. For the amateur maker of manganese bronze the following alloy gives good results: Copper, 46 pounds; manganese copper containing 30 per cent manganese, 12 pounds, zinc, 40 pounds, and aluminum, 2 pounds. Melt the copper and the manganese copper together, then add the aluminum. Follow with the zinc, and ingot the alloy. Remelt the ingots to make the castings. If greater ductility is desired than this alloy will give, decrease the aluminum to 1 per cent and increase the copper correspondingly. This alloy cannot be made from scrap metals. Nothing except new metals and high-grade zinc can be used. While the skillful metallurgist can utilize scrap metals to excellent advantage in making manganese bronze, it is not wise to attempt this until well acquainted with the peculiarities of the alloy, and this requires years of study. For this reason we suggest the alloy given above. It is expensive, but excellent results can be obtained in making it if ordinary precautions are followed while melting.

Electrical Melting Of Alloys—XIII

Future of the Electric Furnace in the Alloy Industry Is Considered as a Whole and in Reference to the Different Types of Furnaces and the Possibilities of Each Class

BY H. W. GILLETT

WHEN, eight years ago, the writer began to study the possibilities of electrical melting of brass there was no commercially successful electric brass furnace in the world, and what few ideas there were as to how such a furnace should be built, were in a most embryonic state. Even the need for such a furnace was but hazily understood. Attention was focused on this need in December, 1911, when a symposium on mineral wastes that had been arranged by C. L. Parsons, in his capacity as secretary of the American Chemical society, was held*. At this symposium the magnitude of the loss of zinc in the brass industry was emphasized. In his capacity as chief chemist of the bureau of mines, Dr. Parsons gave his official attention to this condition. Solution of the problem by electric furnaces was then merely a hope. The resulting study** of the situation showed a real need for electric melting. From 1913 to 1916 there was considerable experimental work done on the subject by several workers, and successful electric furnaces became a probability. By the end of 1917 enough foundry work had been done with electric furnaces to show that they were adapted for the work. The years 1918-1919 brought commercial experience with the furnaces. This resulted in rapid improvement so that in 1920 it is hardly possible to keep up to date a list of electric brass furnaces in commercial use, so rapidly are new installations made.

The rate of growth of electric brass melting has been so great as to prove that it meets a real commercial need sufficiently well to be a good investment for the industry as a whole.

PROPHECY of future developments of the electric furnace may be made along certain lines from a fundamental knowledge of the industry. For instance a prediction can be made with fair accuracy in regard to the future results of the competition of the electric furnace with the fuel-fired furnace, but even this must be modified to allow for unexpected improvements in the fuel-fired furnace. The different types of electric furnaces for melting alloys have been outlined as to their spheres and future expansion. However, the entire trend of one class of furnaces might be changed by some unforseen development. This is illustrated by the history of steel melting furnaces. At first the induction and the direct-arc types competed for supremacy until the arc-type furnace demonstrated decided advantages and replaced the induction furnace almost entirely. While this might have been considered conclusive, a prominent manufacturing company at present is experimenting with induction furnaces and the supremacy of the induction furnace over the arc-type furnace in steel making is yet a possibility

It is certainly of interest, and possibly of value, to speculate on the probable trend of future development of this melting process. Enough development has been done to indicate the possibilities of the various furnaces.

First of all, we may be sure that unless and until some undreamed of development of the future relegates all present electric furnaces to the scrap-heap, there will always be a use for several different types, rather than a monopoly by any one so called *best* electric brass furnace. The nonferrous industry is too ramified and the alloys handled are too different for any one type of furnace to command the situaton, as the direct-arc type predominates in electric steel melting.

However, we may look for a closer fitting of the furnace to the job. Pending the development of the various present types, some of the early users took the first electric furnace available that would handle their work, it being then more a question of a comparison of some particular electric furnace against fuel furnaces than one of comparing several electric furnaces with fuel-fired ones and with each other. Once having an electric furnace installed and finding it to be better than fuel-fired furnaces, when a new furnace was to be put in, familiarity with the operation of the first one has sometimes made it simpler to install another of the same type instead of trying another type, so that the evidence of repeat orders, while important, is not always final.

It is a hopeful sign that so many plants are now trying more than one type. Sooner or later accumulated experience, especially that of plants operating more than one type of furnace, will make it possible to delineate far more clearly than this series of articles has been able to, the different sets of conditions under which each type of furnace will do its best work. The fundamental principles of furnace efficiency are, however, pretty definite and, arguing on the ability of the different types of furnace to meet those principles, it seems to the writer that future electric brass furnace development is not likely to show any rapid change in the relative installation and use of the different types. The direct-arc type should maintain its lead for melting monel metal and similar alloys that are really as close to steel as they are to brass as far as their behavior on melting goes, but direct-arc furnaces even for melting bronze will probably remain rarities.

The stationary indirect-arc type should, as now, fill a small field on bronzes and red metal, but it will probably remain in a minor position.

The induction furnace should, by virtue of its efficiency, hold first place in the task of melting yellow brass 24 hours a day, and as the size of the furnace of this type becomes larger, its grip on this field should become even more secure. If it can be developed to handle alloys high in lead without damage to the lining, and if it can be designed to handle alloys high in copper, and hence of low electrical resistance, without giving too low a power factor, it may find a still wider range of usefulness. It will always have to give way to the other types when suc-

*Bassett, W. H., Zinc Loss Jour. Ind. and Eng. Chem., Vol. 4, 1912, p. 164.
Parsons, C. L., Discussion, Metal Ind., Vol. 10, 1912, p. 240.
Parsons, C. L., Notes on Mineral Wastes, Bull. 47 Bur. Mines, 1912, p. 20.

**Gillett, H. W., Brass Furnace Practice in the United States, Bull. 73, bureau of mines, 1916.

cessive heats of widely different alloys have to be handled. Its needs as to refractories and to its construction in larger sizes will undoubtedly be ultimately met. The design of a furnace of this type which can be completely emptied of molten metal and started up again will probably not be accomplished.

The rocking indirect-arc type, because of its combination of versatility and efficiency, is likely to be called upon to do an increasingly large proportion of the melting in what might be termed the average foundry. The writer looked for the wide application of automatic electrode control to these furnaces, as well as to the stationary indirect-arc and direct-arc furnaces used on brass and bronze, though seldom in plants where the installation consists of only one furnace.

Automatic Control Advantageous

The development of an automatic electrode control device that will work as satisfactorily in the atmosphere of zinc vapor, obtained from the furnace when melting alloys high in zinc, as it does when handling red brass or bronze, is desirable since present devices are not likely to be wholly satisfactory in such service. This development will doubtless be made as experimental work in this direction is now under way.

Whether the rocking indirect-arc type will be used in sizes much above one ton capacity, is hard to predict. It is quite possible that a larger, polyphase form of this type, which is being developed, would be useful in smelting and refining plants, but it is doubtful whether this larger furnace would be an improvement for the ordinary foundry. Whether there will be much use of the tinier furnaces of this type is a question. The writer doubts it.

The future standing of the types so far mentioned seems pretty clear. That of the reflected heat type is less certain. There will always be a field for furnaces of this type, but whether the present leader, the granular resistor form, will be able by virtue of its simplicity and reliability to continue to offset its inability for rapid production and its lack of thermal efficiency, against the competition of higher powered and more rapid and efficient furnaces remains to be seen. The opportunity for improvement in the latter forms of reflected heat furnaces is probably greater than in the granular resistor form. With better refractories, decided improvements may come.

With the inevitable future development of hydroelectric power the relative cost of electricity compared with fuel, will decrease. The importance of thermal efficiency, i.e. low power consumption per ton, will then be less, though it will never be negligible. Constructive legislation looking toward water power development has at last been passed and approved though it will take time to develop the various hydroelectric projects thus made possible and to get them into operation.

Various plans and suggestions have been made for an improvement in the power situation, notably that of Ex-Secretary Lane* for the tying-in together of the steam and water power plants of the eastern seaboard. The development of the proposed St. Lawrence river** to allow ocean vessels to pass would furnish the United States about 800,000 kilowatts of hydroelectric power free from seasonal variations due to low water. The bulk of the hydroelectric developments is, of course, expected in the west, but the schemes cited above show that the east may also improve its power situation. However, all such development require the expenditure of huge amounts of capital*** and take years for completion.

It seems to the writer that unless hydroelectric development comes at a far more rapid rate than is now expected, so that power prices tend to fall at once, the lower efficiency of the reflected-heat type furnaces will tend to bring about, for the immediate future, increased attention to the operation of this type at least 16 hours out of 24. This condition will also induce a less rapid extension of their use in foundries operating on a single shift only.

The need of the granular-resistor type for a resistor trough that will allow the use of a high enough rate of power input to raise the efficiency of the furnace, unfortunately does not seem to likely to be met. The substitution of the *zig-zag* solid resistor for the granular resistor may help, but its value has still to be proved.

Really extended use of the Northrup high frequency eddy current furnace depends primarily on the availability and the cost of high frequency alternators. This furnace is likely to be a commercial standard in 10 years, but it is hard to see how with even the most rapid electrical engineering developments in high frequency current it can become of prominence for large-scale commercial work in the immediate future. It will probably hold a commanding position in small-scale work, as it is the only type that can operate efficiently on small intermittent heats.

*Anon, Secretary Lane's Proposal for Power Resource Survey, El. World, Vol. 73, 1919, pp. 282-331.

See also Murray, W. S., Economical Supply of Electric Power for the Industries and Railroads of the Northern Atlantic Seaboard, Jour. Am. Elect. Eng., Vol. 39, 1920, p. 219.

**Economical Power, the Strongest Agent for Maintaining Supremacy in World's Trade, Jour. Am. Inst. Elec. Eng., Vol. 39, 1920, p. 27.

***Compare Dunn G., The Water Power Situation, Including its Furnace Aspect, Trans. Am. Inst. El. Eng., 1916, p. 575.

If the Bennett contact-resistance furnace is to be sold to firms other than its present exclusive users it may be found to deserve wide use, but with the present lack of knowledge as to its performance no appraisal of its relative merits is possible and no predictions can be made. Of the various other furnaces under development for brass some may have points of merit that will give them a place in commercial work, but it seems unlikely that anything very startling will result from them. It is of course possible that some quite unknown or unrecognized advantage of one of these types of furnace or of some brand new furnace might alter the whole future trend of electric brass melting. However this is a possibility rather than a probability.

Advances in knowledge of refractories and greater availability of better refractories for electric furnace use will come, but progress in this line is likely to be gradual rather than rapid. It is only reasonable to expect also that the future will show an increase in the quality and uniformity of graphite electrodes used by so many electric brass furnaces, as well as a decrease in their cost. Minor advances in construction, rather than in basic design, due to accumulated experience, will be made in all types.

Improvements in general bid fair to be in the nature of refinement of details of the furnaces themselves, in the proper application of existing types to different conditions, and in better operation of present furnaces, rather than in any sweeping changes. One radical change in operation is, however, quite possible. That is the preheating of the charge by fuel outside the electric furnace, and the finishing of the heat in the electric furnace. Theoretically this would show a marked advantage, but it has obvious practical disadvantages. It would be easiest to apply satisfactorily in smelting and refining plant practice, and should be of value there.

Design for Top Charging

If such preheating works out well enough in practice to deserve wide application, it will give a still greater advantage to that already held by the furnaces that can be mechanically charged from the top, since the hot material would have to be charged in this manner. It also would probably cause changes in the design of other furnaces so as to allow top charging.

Auxiliary devices and equipment, such as bundling and briquetting machines, automatic charging devices, pouring systems in which large ladles may be used and the stream of metal directed with the same ease and accuracy as from a small ladle, developments to allow the use of larger molds or to

pour small ones more quickly when the metal is poured direct from furnace to mold, mold conveyors, etc, will be developed further and be fitted into the operation of electric furnaces as the advantage of these appliances in increasing production is more clearly understood.

The writer cannot see much likelihood of any great advance along the line of carrying the furnace bodily to the molds, save under quite unusual conditions. However, there will be need for an efficient electrically heated ladle heater, by which the ladles are heated from the inside, for cases where a plant wishes to go on an entirely electrical basis.

It should not be long before smelting and refining plants operate electric furnaces for making all sorts of brass ingot from scrap, almost to the exclusion of fuel-fired furnaces. This is so because of the ability of the electric furnace to handle large melts and to avoid metal losses, and because plants so equipped can readily operate 24 hours a day and thus take full advantage of the savings effected by continuous operation.

Almost complete electrification of melting in the wrought-brass industry should follow. The conservatism of this industry has been much commented on, but the writer suspects that this is more apparent than real. At any rate, most of the rolling mills for whom their competitors have the most respect have gotten well along toward melting entirely by electricity with such good results that this example is likely to be widely followed by their competitors.

The foundries of large manufacturing plants, and the larger jobbing foundries will doubtless rapidly continue to be equipped for electric melting wherever the cost of electric power is low enough to allow it. In fact, there seems no good reason why the electric furnace, within the next year or so, should not be melting as much of this country's brass and bronze, as is melted in fuel-fired furnaces, and unless conditions change materially the electric furnace should ultimately handle some 90 per cent of this work. It is not impossible that electric melting may have some effect on the geographical location of the brass industry, since the availability of cheap hydroelectric power is a factor that will hereafter have to be considered in the location of a plant.

The saving to the country in metal losses, in crucible cost, in fuel and its transportation, in labor, and by the advantage of substituting a less hot and less arduous method of melting for the older ones, is not inconsiderable even at the present time, and it will become larger as time goes on. This saving will certainly be large enough to justify the time and expense that has been put upon the problem in the last few years by so many investigators.

Outlines Properties of Die Castings

BY CHARLES PACK

DIE castings may be defined as castings made by forcing molten metal, under pressure, into a metallic mold. The die casting process is best adapted to alloys of comparatively low fusing points which may, for convenience, be divided into the following groups:

Zinc alloys, consisting of zinc alloyed with tin, copper, or aluminum; tin alloys, consisting essentially of tin alloyed with copper, lead, or antimony; lead alloys, consisting essentially of lead alloyed with tin or antimony; and aluminum alloys, consisting essentially of aluminum alloyed with copper.

A typical zinc alloy for die castings is that whose composition is zinc, 87.5; tin, 8; copper, 4; and aluminum, 0.5 per cent. Castings made from this alloy should not be used for parts that are subjected to severe stress or sudden shock in service.

The five compositions [illegible] below are typical die casting alloys of the tin group:

	Tin Per Cent	Copper Per Cent	Lead Per Cent	Antimony Per Cent
No. 1	90	4.5	0	5.5
No. 2	86	6	0	8
No. 3	84	7	0	9
No. 4	80	0	10	10
No. 5	61.5	3	25	10.5

Alloy No. 1 is a so-called "genuine babbitt" metal and was used very extensively during the war for mainshaft and connecting-rod bearings on all American-made airplanes and motor trucks. No. 2 is somewhat harder and is used extensively for bearings in internal combustion engines. No. 3 is somewhat harder than alloy No. 2 and is the S. A. E. standard for high grade internal combustion engine bearings. No. 4 is in general use for light bearings on stationary motors. No. 5 is a bearing metal for light duty and is used on a large number of moderate priced automobiles for mainshaft and connecting rod bearings.

Tin alloys find their largest field of application in their use as bearings for internal combustion engines. They are also used for other purposes where a tensile strength of over 8000 pounds per square inch is not essential and where resistance to corrosion is of importance. They are not affected by water, weak acid, or alkaline solutions, and when free from lead, are extensively used for food container parts.

Selecting Lead Alloys

The following four compositions are those of lead alloys widely used in the production of die castings:

	Lead Per Cent	Tin Per Cent	Antimony Per Cent
No. 1	83	0	17
No. 2	90	0	10
No. 3	80	10	10
No. 4	80	5	15

Alloy No. 1 is generally known as C. T. metal, due to its extensive use in the manufacture of coffin trimmings. This alloy is also a good bearing metal for light duty and is employed for thrust washers and camshaft bearings on light internal combustion engines. No. 2 is somewhat softer and more ductile than No. 1. No. 3 is much used for light bearing duty, being somewhat tougher and stronger than Nos. 1 and 2. No. 4 is somewhat harder than No. 3 but less ductile. Many similar alloys may be compounded, all of which may be die cast readily.

Lead alloys may be used where a metal of noncorrosive properties is desired and where a tensile strength of not over 8000 pounds per square inch will suffice. They should not be used for parts that may come in contact with foods or that may be handled often in service, since the poisonous properties of lead and lead alloys are well known.

A typical aluminum alloy for use in die casting work has the following composition: Aluminum, 92 per cent; copper, 8 per cent.

The alloy is well known in the arts as No. 12 alloy and is used very extensively for automobile and airplane parts. By varying the copper content harder or softer alloys may be obtained, all of which may be die cast successfully. Aluminum die castings find wide employment in the manufacture of parts of automobiles.

The cost of die castings cannot be computed on the pound basis since it depends on the design of the piece, the number and position of the cores, the quantity to be produced and certain other factors. For comparative purposes it may be stated that at the present time tin alloy castings are the highest in cost, being followed by those of aluminum alloy, zinc alloy, and lead alloy in the order named.

From a paper presented at a recent meeting of the American Society of Mechanical Engineers. The author, Charles Pack, is chief chemist, Doehler Die Casting Co., Brooklyn.

A. F. A. Exhibits to Establish Record

More Display Space Sold for Columbus Convention than on Any Previous Occasion —Large Attendance Expected to See Latest Foundry Equipment and Appliances, and to Hear Technical Papers

PROSPERITY and growth of the casting industry will be reflected in the exhibits to be presented to the attention of the visitors to the annual convention of the American Foundrymen's convention to be held in Columbus, O., Oct. 4 to 8. Already the highest previous record for space occupied by exhibitors, made at the convention in Philadelphia last year when 60,000 square feet were taken, has been passed by nearly 15 per cent. A list of exhibitors registered up to Aug. 10 is appended. The number is constantly increasing and promises to be well over 200. The complete list giving the location of the different exhibits together with a description of the appliances to be exhibited by each company and the names of the men in charge of the various booths, will be published in full in the Sept. 15 issue of THE FOUNDRY.

An interesting program of papers is being prepared under the direction of the committee on papers, W. R. Bean, Eastern Malleable Iron Co., Naugatuck, Conn., chairman. The Ohio State fair grounds, at which the convention is to be held, have large and well appointed buildings for the exhibits as well as auditoriums for the technical meetings, and Columbus will afford ample hotel accommodations for those attending the meeting. A larger gathering than usual is expected due to the interesting program and the large volume and assortment of exhibits, together with the central location of Columbus which is not more than a night's journey from nearly all the manufacturing centers east of the Mississippi. A number of entertainment features also are being arranged.

List Of Exhibitors Registered For Columbus Show

Acheson Graphite Co., Niagara Falls, N. Y.
Air Reduction Sales Co., New York
Ajax Metal Co., Philadelphia.
Akron Cultivator & Mfg. Co., Akron, O.
American Boron Products Co., Reading, Pa.
American Foundry Equipment Co., New York
American Hominy Co., Indianapolis
American La France Fire Engine Co., Pittsburgh.
American Molding Machine Co., Terre Haute, Ind.
American Woodworking Machinery Co., Rochester N. Y.
Arcade Mfg. Co., Freeport, Ill.
Asbury Graphite Mills, Asbury, N. J.
Ashland Brass Foundry, Ashland, O.
Atkins, E. C., & Co., Indianapolis
Austin Co., Cleveland.

Bacharach Industrial Instrument Co., Pittsburgh
Baker Bros., Toledo, O.
Barrett-Cravens Co., Chicago.
Bauer, A. E., & Son, Chicago.
Bausch & Lomb Optical Co., Rochester, N. Y.
Beaudry & Co., Boston.
Berkshire Mfg. Co., Cleveland.
Birkenstein, S., & Sons, Inc., Chicago
Black Diamond Saw & Machine Co., Natick, Mass.
Blaw-Knox Co., Pittsburgh.
Blystone Mfg. Co., Cambridge Springs, Pa.
Booth Electric Furnace Co., Chicago
Brass World Publishing Co., New York
British Aluminum Co., Ltd., New York
Brown Instrument Co., Philadelphia.
Buckeye Products Co., Cincinnati.

Carborundum Co., Niagara Falls, N. Y.
Caward Gaskill-Furnace Corp., Chicago.
Champion Foundry & Machine Co., Chicago.
Chase, Frank D., Inc., Chicago.
Chase Foundry & Mfg. Co., Columbus, O
Chesapeake Iron Works, Baltimore.
Chicago Pneumatic Tool Co., New York
Clark Truetractor Co., Buchanan, Mich.
Cleveland Flux Co., Cleveland.
Cleveland Pneumatic Tool Co., Cleveland.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Coale, Thomas E., Lumber Co., Philadelphia.
Combined Supply & Equipment Co., Buffalo.
Corn Products Refining Co., New York
Curtis Pneumatic Machinery Co., St. Louis
Chicago Crucible Co., Chicago.
Cooper Mfg. Co., York, Pa.

Daily Iron Trade and Metal Market Report, Cleveland.
Davenport Machine & Foundry Co., Davenport, Iowa.
Davis Bournonville Co., Jersey City, N. J.
Dayton Pneumatic Tool Co., Dayton, O.
Detroit Electric Furnace Co., Detroit.
Diamond Clamp & Flask Co., Richmond, Ind.
Dings Magnetic Separator Co., Milwaukee.
Disston, Henry, & Sons, Inc., Tacony, Philadelphia
Dixon, Joseph, Crucible Co., Chicago
Doggett, Stanley, Inc., New York.

Electric Furnace Co., Salem, O.

Federal Foundry Supply Co., Cleveland.
Federal Malleable Co., West Allis, Wis.
Firefoam Service & Supply Co., Cleveland.
Foreign Crucibles Corp., Ltd., New York.
Foundry Equipment Co., Cleveland.
THE FOUNDRY, Cleveland.

Gardner Machine Co., Beloit, Wis.
Geirt Mfg. Co., Atlantic City, N. J.
General Electric Co., Schenectady, N. Y.
Gordon, Robert, Inc., Chicago.
Great Western Mfg. Co., Leavenworth, Kans.
Great Western Smelting & Refining Co., Chicago.
Grimes Molding Machine Co., Detroit
Gurney Ball Bearing Co., Jamestown, N. Y.

Hardy, Clement A., Co., Chicago
Hardy, F. A., & Co., Chicago.
Harris, Benjamin, & Co., Chicago
Haskins, R. G., Co., Chicago
Hauck Mfg. Co., Brooklyn, N. Y.
Hausfeld Co., Harrison, O.
Haynes Stellite Co., Kokomo, Ind.
Heald Machine Co., Worcester, Mass.
Hill-Brunner Foundry Supply Co., Cincinnati.
Hill & Griffith Co., Cincinnati.
Hoevel Mfg. Corp., Jersey City, N. J.
Holland Core Oil Co., Chicago.
Humphreys, E. C., & Co., Chicago

Independent Pneumatic Tool Co., Chicago.
Industrial Electric Furnace Co., Chicago.
Ingersoll-Rand Co., New York
International Molding Machine Co., Chicago.
Interstate Sand Co., Zanesville, O.
Iron Age, New York
Iron Trade Review, Cleveland.

Jones Sand Co., Columbus, O.

Kawin, Charles C., Co., Chicago.
Keener Sand & Clay Co., Columbus, .
Keller Pneumatic Tool Co., Chicago.
Kellogg, Spencer, & Sons, Inc., Buffalo.
Kelly, T. P., & Co., Inc., New York.
King Refractories Co., Inc., Buffalo.
Kinsey, E. A., Co., Cincinnati.
Knoeppel, C. E., & Co., Inc., New York.

Lakewood Engineering Co., Cleveland.
Lane, Henry M., Co., Detroit.
Lindsay Chaplet & Mfg. Co., Philadelphia.
Link Belt Co., Chicago.
Louden Machinery Co., Fairfield, Iowa.
Lucas Machine Tool Co., Cleveland.
Lupton's, David, Sons Co., Philadelphia.

McCormick, J. S., Co. Pittsburgh.
McLain's System, Milwaukee.

MacLean Publishing Co., Toronto, Ont.
MacLeod Company, Cincinnati.
Magnetic Mfg. Co., Milwaukee.
Mahr Mfg. Co., Minneapolis.
Malleable Iron Fittings Co., Branford, Conn.
Marden, Orth & Hastings Co., Inc., New York.
Maxon Furnace & Engineering Co., Muncie, Ind.
Menefee Foundry Co., Fort Wayne, Ind.
Metal Industry, New York.
Metal Saw & Machine Co., Springfield, Mass.
Metal & Thermit Corp., New York.
Michigan Smelting & Refining Co., Detroit.
Milburn, Alexander, Co., Baltimore.
Monarch Engineering & Mfg. Co., Baltimore.
Mott Sand Blast Mfg. Co., Brooklyn, N. Y.
Mumford Molding Machine Co., Chicago.
National Engineering Co., Chicago
National Scale Co., Chicopee Falls, Mass.
Nicholls, William H., Co., Inc., Brooklyn, N. Y.
Norma Co. of America, Long Island City, N. Y.
Norton Co., Worcester, Mass.

Obermayer, S., Co., Chicago.
Ohio Body & Blower Co., Cleveland
Ohio Equipment Co., Cleveland
Oldham, George, & Son Co., Philadelphia.
Oliver Machinery Co., Grand Rapids, Mich.
Osborn Mfg. Co., Cleveland.
Osborne & Sexton Machinery Co., Columbus.
Oxweld Acetylene Co., Chicago

Pangborn Corporation, Hagerstown, Md.
Paxson, J. W., Co., Philadelphia.
Penton Publishing Co., Cleveland.
Pickands, Brown & Co., Chicago.
Pittsburgh Crushed Steel Co., Pittsburgh.
Portage Silica Co., Youngstown, O.
Pridmore, Henry E., Inc., Chicago.

Quigley Furnace Specialties Co., New York.

Racine Tool & Machine Co., Racine, Wis.
Railway Mechanical Engineer, Chicago.
Raymond Bros. Impact Pulverizer Co., Chicago.
Richards-Wilcox Mfg. Co., Aurora, Ill.
Rogers, Brown & Co., Cincinnati.
Roots, P. H. & F. M., Co., Connersville, Ind.

Safety Equipment Service Co., Cleveland.
Safety First Shoe Co., Providence, R. I.
Simonds Mfg. Co., Fitchburg, Mass.
Sly, W. W., Mfg. Co., Cleveland.
Smith, R. P., & Sons Co., Chicago.
Smith, Werner G., Co., Cleveland.
Spencer Turbine Co., Hartford, Conn.
Standard Equipment Co., New Haven, Conn.
Standard Sand & Machine Co., Cleveland.
Sterling Wheelbarrow Co., Milwaukee.
Stevens, Frederic B., Detroit.
Stodder, W. F., Syracuse, N. Y.
Sullivan Machinery Co., Chicago.
Superior Sand Co., Cleveland.

Transport[illegible] Engineering Corp., Chicago.
Thomas Elevator Co., Chicago.
Torchweld Equipment Co., Chicago.
Truscon Steel Co., Detroit.

United Compound Co., Buffalo.
United States Graphite Co., Saginaw, Mich.
U. S. Molding Machine Co., Cleveland.
United States Silica Co., Chicago.
U. S. Smelting Furnace Co., Belleville, Ill.

Vibrating Machinery Co., Chicago.

Wadsworth Core Machinery & Equipment Co., Akron, O.
Wallace, J. D., & Co., Chicago.
Warner & Swasey Co., Cleveland.
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.
Westinghouse Electric & Mfg. Co., Pittsburgh.
Westinghouse Traction Brake Co., Pittsburgh.
White & Bro., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.
Whitman & Barnes Mfg. Co., Akron, O.
Woodison, E. J., Co., Detroit.
Wood's, T. B., Sons Co., Chambersburg, Pa.

Young Bros. Co., Detroit.

Comparing Costs of Steel Making

Statement of Cost Covering the Operation During Four Months of a 20-Ton Acid Open-Hearth Furnace and a 6-Ton Basic Electric Furnace Are Compared and Discussed

BY E. H. BALLARD

THE advance made during the past few years in practically all branches of manufacturing in no case has been more pronounced than in the steel casting industry. Prior to the war many modern foundries were built with many of the objectionable features of the old time foundries omitted, the builders having in mind only such features as spell efficiency, features that would lower the cost of production.

Electric steel-melting furnaces were installed in a number of foundries with satisfactory results. Without the electric furnace it is doubtful if the steel casting industry would have been able to contribute such a variety of necessary articles needed in carrying on the war. Particularly is this true in the case of gun castings, truck wheels and parts, ship castings, anchor chains, etc., all of which presented many difficulties which were only overcome by the persistent efforts of the foundrymen called upon to produce them.

The increase in the number of electric furnace installations in 1917 and 1918 and the report of their successful operation caused the authorities in charge of the Lynn works of the General Electric Co., to make a thorough investigation into their possibilities. A 5-ton electric furnace has been operated successfully for a number of years at the Schenectady plant of the same company and it may appear strange that Lynn foundrymen have been so backward in not making the investigation earlier. The reason is that the acid open-hearth furnaces at the Lynn plant have been able for the past 26 years to produce practically all classes of castings required, varying in weight from one pound to 30 tons and successfully meeting all physical and chemical specifications.

To maintain production from the open-hearth furnaces at reasonable cost, and to keep pace with the labor shortage, the entire open-hearth department has been rearranged. Many changes have been made including the installation of traveling cranes with lifting magnets and a mechanically operated charging machine. Economical methods

Paper presented before the American Foundrymen's association Philadelphia convention. The author, E. H. Ballard, is connected with the General Electric Co., at the West Lynn works, West Lynn, Mass.

Comparison of Costs of Electric and Open-Hearth Steel

Electric Furnace

Per cent	Metal charged	Price	Per	Cost per N. T.
1.00	Pig iron	$ 51.00	G. T.	$0.46
1.00		51.00	G. T.	0.46
	Scrap			
20.13	Foundry accumulations	18.00	G. T.	3.50
1.64	Castings from scrap department	18.00	G. T.	
15.63	Scrap 0.06 unguaranteed	21.25	G. T.	2.97
0.49	Nickel Turnings	21.50	G. T.	0.09
58.71	Steel turnings	8.50	G. T.	4.45
0.55	Nickel accumulations	21.50	G. T.	0.11
0.60	Iron borings	12.00	G. T.	0.06
97.75		12.80		11.18
	Special metals			
0.54	Ferrosilicon	155.00	G. T.	0.74
0.37	Ferromanganese	225.00	G. T.	0.74
0.09	Wash metal	71.20	G. T.	0.06
0.07	Aluminum titanium	166.00	G. T.	0.12
0.04	Nickel	0.50	Lb.	0.38
0.06	Copper	20.16	100 lbs.	0.23
0.08	Iron ore	9.16	G. T.	0.01
1.25		204.38	G. T.	2.28
100.00	Total metal charged	15.59	G. T.	13.92
	Molten metal cost			
	Cost of metals			13.92
	Direct labor			2.00
	Items of expense—(per detail below)			21.58
100.00	Total cost of melt			37.50
8.00	Shrinkage			
92.00	Cost of metal in ladle			40.52
30.90	Credit—Scrap produced	16.16	N. T.	
61.10	Good castings produced			53.06
	Summary of expense			
	Electrodes (30 lbs. per net ton melt)	0.08	Lb.	2.52
	Current	0.0125	KW.	9.05
	Oil-ladle	0.079	Gal.	0.26
	Water			0.24
	Slagging material—(Lime, Fluor spar, syndolag, carbon, coke)			1.79
	Furnace bottom sand	4.47	N. T.	0.01
	Ladle repairs			0.43
	Furnace repairs			1.27
	Royalty (average per net ton output) $0.446			0.27
	Depreciation 10 per cent			1.14
	Expense—Labor			1.30
	Expense—All other			3.30
	Total melting expense			21.58

Heats poured, 131.
Average weight per heat, 13,918 pounds.
Metal melted per 100 kilowatts, 275 pounds.
Kilowatt-hours per net ton melted, 720 kilowatts.

Open-Hearth Furnace

Per cent	Metal charged	Price	Per	Cost per N. T.
10.82	Pig iron Delaware	$ 51.00	G. T.	$3.45
	Robersonia	50.00	G. T.	1.45
10.82		50.70	G. T.	4.90
	Scrap			
40.40	Foundry accumulations	18.00	G. T.	
0.87	Foundry scrap castings	18.00	G. T.	8.05
8.80	Castings from Scrap Department	18.00	G. T.	
2.15	Scrap 0.06 unguaranteed	21.25	G. T.	0.46
18.08	Scrap 0.04 guaranteed	24.78	G. T.	4.00
16.10	Bundled sheet	12.05	G. T.	1.77
87.00		18.37	G. T.	14.28
	Special metals			
0.52	Ferrosilicon	155.00	G. T.	0.68
1.20	Ferromanganese	225.00	G. T.	2.60
0.01	Wash metal	71.20	G. T.	0.01
0.11	Aluminum titanium	166.00	G. T.	0.18
	Silico Manganese	270.00	G. T.	0.01
	Aluminum	0.175	Lb.	
0.21	Iron ore	9.16	G. T.	0.02
0.04	Spiegeleisen	60.00	G. T.	0.02
2.18		180.91	G. T.	3.52
100.00	Total metal charged	25.42	G. T.	22.70
	Molten metal cost			
	Cost of metals			22.70
	Direct labor			0.83
	Items of expense (per detail below)			9.95
100.00	Total cost of melt			33.48
8.00	Shrinkage			
92.00	Cost of metal in ladle			36.38
35.06	Credit—Scrap produced	16.05	N. T.	16.05
	Summary of expense			
56.34	Good casting produced			49.24
	Fuel oil—O. H. fur., gallons	0.079		3.65
	Furnace bottom sand	4.47	N. T.	0.25
	Ladle repairs			0.22
	Furnace repairs (actual—labor and material)			0.77
	Depreciation (10 per cent on original cost)			0.98
	Expense labor			1.46
	Expense, all other			2.62
	Total melting expense			9.95

Heats poured, 162.
Average weight per heat, 37,358 pounds.
Metal melted per 100 gallons oil, 4500 pounds.
Fuel oil per net ton melted, 44.4.

of using fuel oil have been introduced and as a result it has been possible under favorable circumstances to melt steel at a cost of 37 gallons of oil per ton. These factors have made it possible to deliver molten metal in the ladle cheaper than it could have been done by the electric process.

With radical changes in the design of much of the product, the engineering department began calling for work difficult if not impossible to make by the open-hearth process. The proposition was particularly difficult when only a small quantity of alloy or special carbon steel was required. Producing small heats in an open-hearth furnace is an expensive process, and it is not good business policy to make a full sized heat requiring special mixtures, using only a small portion for the particular work desired, and pouring the remainder into regular commercial work.

From the investigation of the electric furnace process it seemed that it would meet the requirement. A 6-ton basic lined heroult-type furnace was completed and installed in the latter part of 1918. Regular production was commenced in December, 1918, with an entirely inexperienced organization. The furnace was operated for four months, day shift only, enabling us to secure actual cost data.

The writer believes that the costs of the electric furnace are comparable with those of the open-hearth when it is considered that the product is superior and is fully meeting chemical and physical requirements. It will be noted that in analyzing costs the current consumption per net ton in the ladle is 720 kilowatts. This apparent high consumption is due to the fact that 60 per cent of all heats are double slagged. A conservative estimate for single slag heats, operating according to our practice, is 650 kilowatts. The power charge of $1 per 100 kilowatt is abnormally high. A material saving in labor costs could be effected by employing a mechanical charging device which would reduce the charging time.

During the four-month period, used as a basis for cost comparison, both the electric and open-hearth furnaces were operating on short time, due to lack of business. Also it should be remembered that figures of a 6-ton basic electric furnace are compared with a 20-ton open-hearth acid furnace. There are a number of items entering into the cost of both processes which would be somewhat modified providing both were run at full capacity. It is indeed uncertain and unreliable to make up figures in any other way than on the basis of actual running cost. The figures are presented on this basis in hopes they will serve for comparison and be of material benefit to foundrymen.

In analyzing costs, the metal charge of $11.18 per net ton for the electric furnace should be noted. Substituting steel turnings at $8.50, gross ton, in place of 0.06 scrap which was used, would reduce the metal charge by $1.66 per net ton of melt. This mixture is practical and would have been used in our case if turnings had been available at the time.

Analyzing Comparative Costs

The cost of special metals for the electric furnace was $2.28 per net ton. For actual comparison we should eliminate the charge for nickel and copper, replacing 1749 pounds with ordinary scrap. This would reduce the special metal charge 49 cents per net ton.

In analyzing the expense items of the electric furnace, a current charge of $1 instead of $1.25 per 100 kilowatts should be assumed. This item would be reduced $1.80 per net ton of melt. The fuel oil charge for the open hearth is $7.90 per 100 gallons. A conservative price for oil would be $5 per 100 gallons. The fuel oil consumption, as shown in cost, is 44.4 gallons per net ton of melt. This is high due to furnace operating on short time. If a consumption of 37 gallons per net ton of melt at 5 cents per gallon is assumed, the fuel oil cost per net ton of melt would be reduced $1.85.

With the open-hearth furnace operating full time a number of cost items would be materially reduced, as follows:

Direct labor	$0.24 per net ton
Expense labor	0.50 per net ton
General expense	0.75 per net ton
Depreciation	0.25 per net ton
Repairs	0.24 per net ton
Total	$1.98 per net ton

Without going into detail as to the low fuel oil consumption per net ton of melt in the open-hearth furnace, the writer would be pleased to give such information as has been gained in the investigation which has allowed us to reduce consumption to this figure. In passing, it should be stated that these figures are not estimates but are actual tank measurements, checked by accurate oil meters, and include the heating of ladle, and week end heating of furnace.

The writer believes that foundrymen will agree that the exceptions above noted are not in the least exaggerated. They are shown in order to present the best comparison the figures will permit, assuming both furnaces are operating under normal and reasonably full time conditions. With the reductions, as above noted, a summary of costs is as follows:

	Electric furnace Net ton	Open hearth Net ton
Pig iron	$0.46	$ 4.90
Special metals	1.79	3.52
Steel turnings, scrap, etc.	9.52	14.28
Expense items	19.78	6.30
Direct labor	2.00	.59
Total cost of metals	$33.55	$29.65
Cost in ladle (8 per cent loss)	36.57	32.55

After seven months' observation of both processes we have decided that for special purposes the electric process is superior to the open-hearth and consider the additional cost not prohibitive.

The following are some of the reasons on which this opinion is based:

Freedom from serious checks in castings, due to absence of oxides, and the lower phosphorus and sulphur content.

High temperature easily attained, adapting it for light section casting.

Carbon and alloy ingots up to 13½ inches show marked superiority over ordinary open-hearth product, due to more complete deoxidation of the steel, producing a sounder ingot with less pipe and freedom from segregation, with superior forging and heat-treating qualities.

Possibility of taking small portions of heat, producing different compositions from the same heat.

Permits of intermittent running with less damage to furnace than to the open hearth.

Flexibility of working in conjunction with open hearth, permitting the casting of pieces beyond the capacity of one furnace.

Low cost of furnace charge, practice permitting a charge of 75 per cent steel turnings with 25 per cent foundry scrap, an advantageous low-priced mixture.

Low cost of producing a high grade steel for both castings and ingots.

Scrap produced by electric furnace used in open hearth as 0.04 per cent material, improving finished product of open hearth at a saving in price of 0.04 per cent material.

Wants Equipment For New Foundry

In order to finance the erection of plant additions, the Lavelle Foundry Co., Anderson, Ind., recently increased its capital. Work has started on the erection of a small foundry at Argos, Ind., and the company has in mind the erection of another plant in Indiana. The company is in the market for the necessary foundry equipment for the plants.

In the electric smelting of manganese ores in California there are at Heroult two 3-phase Noble furnaces which reduce 400 tons of ore per month. It has an average manganese content of 45 per cent and a silicon content of 15 per cent. The product contains 70 per cent of manganese.

Checking Brinell Testing Machines

Periodic Calibration of Hardness Machines Is Recommended—Simple Arrangement of Weights Acting Through a Lever of Known Ratio is Used

BY J. L. JONES AND C. H. MARSHALL

WHILE making a series of brinell tests which required a greater degree of accuracy than usual, it was found in the physical testing laboratory of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., that results obtained by two different machines did not agree. Although the loads recorded by the gages were identical, the diameters of the impressions were not the same. Naturally the gages were thought to be incorrect ;but even after the gages had been carefully standardized, the different machines gave results which did not agree. The need of a convenient means of checking these machines directly was felt and the simple lever balance was built and found to answer the purpose.

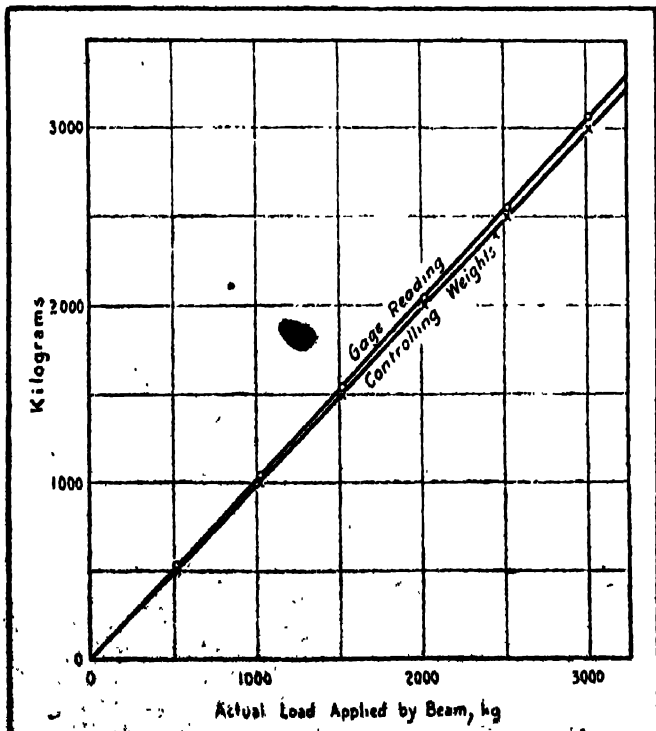
This balance consists of a single beam and a support. They are made of forged steel, machined for lightness and finish, with hardened steel knife edges and bearings. The knife edges are so placed that a multiplying ratio of practically 25 to 1 is obtained. This ratio, as checked by placing the beam in a 5000-pound Riehle testing machine, was found to be 25.02 to 1. The beam alone was found to exert an upward pressure of 322.3 kilograms. A hanger and several lead disks of convenient size were made and carefully weighed. By applying these weights, it is possible to obtain various pressures up to a maximum of 3000 kilograms.

In calibrating a machine, the adjusting screw is removed and replaced by the support, which carries a hardened steel bearing for the knife edge of the beam. The brinell ball is removed and a block carrying a knife edge inserted in its place.

The calibration of an Aktiebolaget Alpha brinell machine gave results shown graphically in Fig. 1. The gage readings are plotted as ordinates for one curve and the load produced by the controlling weights for the other. The actual load as applied by the beam is plotted as abscissae for both curves. As the controlling weights of this type of machine determine the pressure on the brinell ball, their weight should be increased or decreased so that they just balance at the proper load when applied by the beam. The gage should also be calibrated to give the correct reading under the same governing conditions.

The calibration of the improved American model brinell machine is somewhat easier, as no controlling weights are used; it only is necessary to adjust the gages to give the correct reading of load applied by the beam. The results obtained on one of these machines are given in Fig. 2. The curve marked *A* was made with the piston in the highest working position, while that marked *B* is for a lower working position. The position of the piston for the *A* curve is the same as it would be in testing hard material, where a shallow impression is made, while the position for the *B* curve is the same as it would be in testing soft materials, where a deep impression is made. The values of *A* are seen to be lower than those of *B*. This is probably because the distance between the rubber diaphragm and the top of the piston is increased when the piston is at a lower point. The tendency of the rubber to curve at the edges is then greater. The working area of the piston would therefore be less, which would require a higher gage pressure to produce the same load on the brinell ball. However, the error introduced by this is so small that it is ordinarily negligible

Abstract from a paper presented at the June meeting of the American Society for Testing Materials.



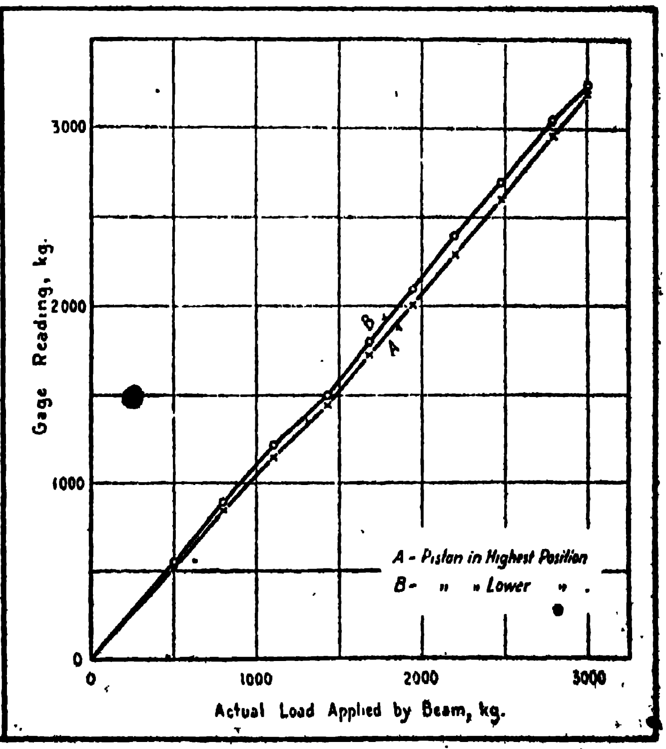


FIG. 1—CORRECTION CURVE FOR AKTIEBOLAGET ALPHA MACHINE. FIG. 2—CORRECTION CURVE FOR AMERICAN MODEL BRINELL TESTING MACHINE

How a Gap-Press Frame Was Molded

Details of Molding Practice on One of These Jobs—Preparing the Bed —Leveling and Adjusting the Pattern—Setting the Cores— Assembling and Closing the Mold

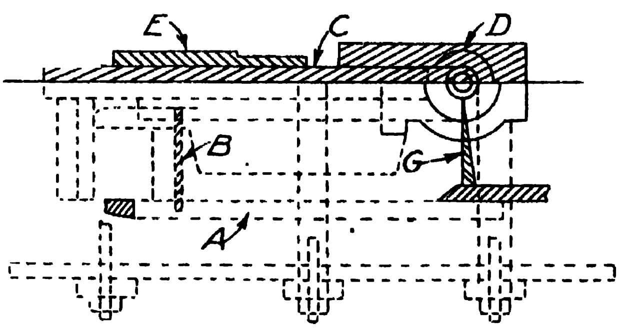
BY M. H. POTTER

THE gap-press frame discussed in this article was molded in a pit which was dug about one foot deeper than the depth of the pattern. A cinder bed, about 4 inches thick, was made and pipes were provided for carrying the gases away from the bottom of the mold when it was poured. The plank, A, Fig. 1, was placed as shown and was used for holding the chaplets supporting the core. Molding sand then was rammed over the cinder bed, to conform as nearly as possible to the under side of the pattern. The pattern was then forced into place, having been blocked and wedged into proper position; it was held in place by weights during the process of ramming the sand underneath.

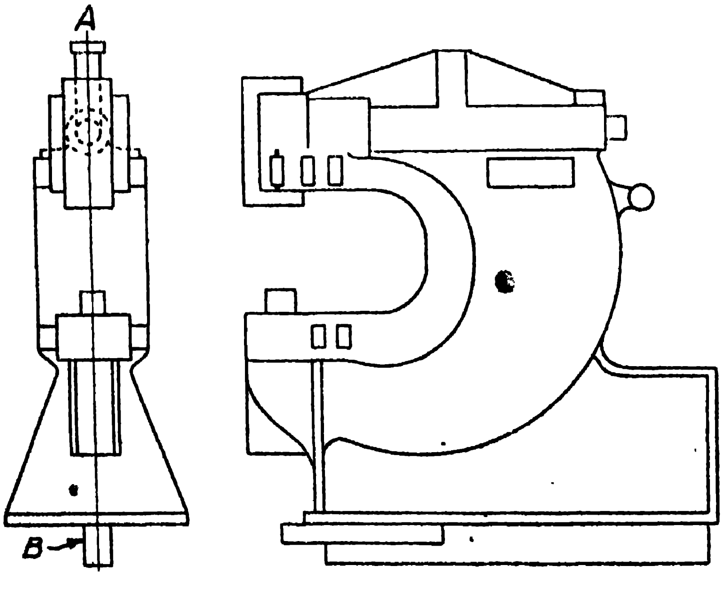
The pattern was parted at *A*, Fig 2, and that part of the pattern below the parting was bedded in the pit, as shown in Fig. 1. The coreprint for the main core is indicated by *B*, Fig. 2. A flat iron plate was placed under this print to support the weight of the heavy main core. As the face of the feet must be fairly true and also carry a heavy strain a slab core was set to bear against it. When the sand had been rammed underneath the pattern the stakes, shown at *A*, Fig. 3, were driven and the pattern was lifted.

The bottom of the mold was well vented, the vents having extended into the bed of cinders. The bottom of the mold was made as smooth as possible before the pattern was reset and rapped down. The stakes, *A*, Fig 3, then were removed, facing sand was laid against the pattern and heap sand was rammed solidly around it, struck off and the joint was made. Parting sand was dusted on the joint, and the cope half of the pattern was placed on the drag. The cope, Fig. 4, was lowered over the pattern and held in place with stakes, *A*, Fig. 4, after which it was lifted and wet down or clay-washed. The pattern was then covered with facing sand. A slab core was placed against the foot, which was provided with a staple to permit of wiring it to the cope. Gates, risers and long stem gaggers were set in position. The pattern then was covered with facing sand and heap sand was hand-rammed to a depth of about 2 inches. Heap sand was added and several rammings performed until the top of the foot on the pattern was reached. As this is the highest part of the mold riser was placed on top of this foot. After placing the riser, sand was shoveled into the flask and rammed until the cope was filled. The cope was well vented and the core at the foot was secured. Gate sticks and risers were next removed and the cope lifted off. The pattern was drawn, the cope was finished and was coated with graphite.

Before drawing the drag part of the



PART OF THE PRESS MOLD BEDDED IN THE FLOOR



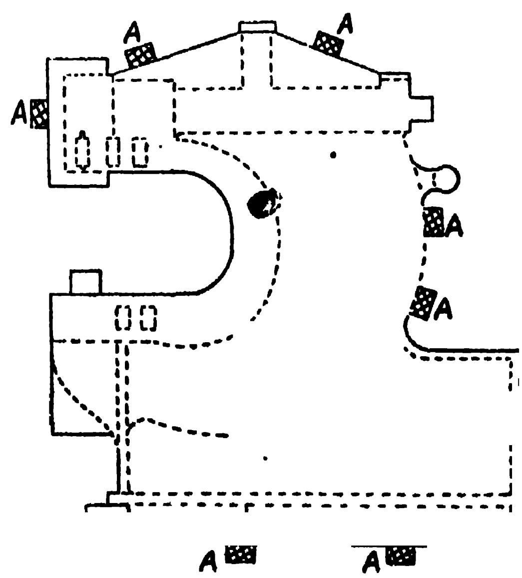


FIG. 2—FRONT AND SIDE ELEVATIONS OF THE PATTERN FIG. 3—HOW THE PATTERN WAS STAKED IN THE FLOOR

pattern the screws holding it to the base were removed. In the corner formed by the foot of the bracket, iron rods, ½-inch in diameter, were driven to support the sand. The foot portion of the pattern then was drawn and the mold finished.

Large-headed nails were pushed into the face of the mold around the jaw and the edges of the base. This prevented the heavier parts of the casting from scabbing. It was found advisable to replace the heavy graphite coating on the parts of the mold forming thin portions of the casting with a thin coat. The drag was gated and nails were forced down into the sand in front of the gates.

As a *blind* core print was used, it was held in place by chaplets. These were driven through the sand in the

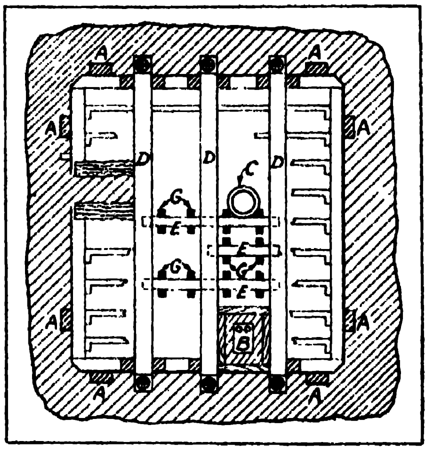


FIG. 4—TOP VIEW OF THE MOLD SHOWING BINDERS, GATE AND RISERS

pit, into the plank, *A*, Fig. 1, and extended above the face of the mold the thickness of the casting as shown at *B*, Fig. 1. The main core, *C*, Fig. 1, was then set, with one end in the core print and the other was supported by chaplets. Cores *D* and *E*, Fig. 1, were set next, followed by the shaft core, one end of which rested in the core *D*, while the other was held by a chaplet, *G*, in the coreprint.

The runner, *B*, Fig. 4, consisted of an iron ring placed around the riser, *C*. Two pieces of pig iron were placed on each side of the gate stick and formed the flow-off, *D*, Fig. 4. The cope was tried on the drag and was immediately removed and repaired where necessary. It is advisable to place white sand on such parts as may be doubtful of bearing properly. When the cope has been made to bear on the joints and cores as desired, a vent wire is run up through the cope and the chaplets are set at the indicated points. The stems of the chaplets should be long enough, so that when they are pushed up through the holes in the cope made with the vent wire, they will extend about ¼-inch, above the top of the cope and still leave in the mold a length of chaplet equal to the thickness of the casting. The chaplets are held in place by soft clay squeezed around the top of the stem projecting through the cope. Paste is placed on the edges of the cores so that the iron cannot *fin* over them and enter the vents, thereby preventing the escape of gases.

The cope is closed over and the riser, *C*, Fig. 4, is covered. Binders, *D*, Fig. 4, are placed on top of the cope, blocks of iron being set between these binders and the edge of the cope. The binders are held down by hook bolts that engage eyebolts in the floor. To keep the main core from rising when the metal is poured into the mold, the binders, *E*, Fig. 4, are passed beneath the binders *D*, and are held by wedges. Wedges, *G*, are pushed in between these binders and the tops of the chaplets. The mold then is ready for pouring.

Compiles Census of Iron Foundries in Britain

An interesting census of the number of iron foundries in Great Britain has recently been completed. It was compiled, it is understood, by the board of trade with the co-operation of the British Gray and Malleable Cast Iron Research association, Birmingham. These figures show that there are 2796 iron foundries in Great Britain, of which 2439 are in England, 305 in Scotland and 52 in Ireland. The particulars according to districts are given in the accompanying table. This census also has revealed the fact that the city of Birmingham has more foundries than any other town in Great Britain. There are 118 iron foundries in the Birmingham area. Yorkshire, with 408 iron foundries, is the most important English county from a foundry standpoint. According to figures compiled from the same source, it is estimated that the output of malleable cast iron in Great Britain in 1913 was 75,000 tons; during the same year the output of gray-iron castings is estimated to have been 3,000,000 tons. It is not believed that these figures have been very largely increased since the war, inasmuch as the war did not call for extensive expansion of gray-iron or malleable casting facilities.

Number of Foundries in Great Britain

ENGLAND	
NORTHERN COUNTIES	
Northumberland, Cumberland, Durham, Westmoreland, Lancashire, Yorkshire	881
MIDLAND COUNTIES	
Staffordshire, Worcestershire, Warwickshire, Leicester, Derbyshire, Nottinghamshire, Northants	828
WESTERN COUNTIES	
Wales, Chester, Salop, Hereford, Monmouth, Gloucester, Somerset, Devonshire, Cornwall	821
EASTERN COUNTIES	
Lincolnshire, Norfolk, Cambridgeshire, Huntingdonshire, Suffolk, Essex, Bedfordshire, Buckinghamshire, Hertfordshire	174
SOUTHERN COUNTIES	
Berkshire, Wiltshire, Dorset, Hants, Sussex, Surrey, Kent, Middlesex, Oxford	137
LONDON	98
	2439
SCOTLAND	305
IRELAND	52
Total	2796

Homer Furnace Co. Starts Foundry School

A school for the education of workmen in foundry practice and metallurgy, known as the Coldwater School of Foundry Technology, was started recently by the Homer Furnace Co., Coldwater, Mich. This new feature is the idea of H. D. Keller, superintendent, who desires to educate the employes of the company to become more proficient and to fill many positions where executive ability is necessary. The course of instruction was prepared by David McLain, McLain's System, Milwaukee. It consists of 12 lessons, each lesson to cover a period of about two months. Besides the lessons from the McClain school Mr. Keller, will give instruction in the plant During the course weekly lectures will be given by Messrs. McLain and Keller, and others will be called to lecture on special subjects on which they are known to be proficient.

Tector Co. Incorporated

The R. J. Tector Co., Muskegon, Mich., recently incorporated with a $300,000 capital stock, will manufacture under contract molding machines, etc. The company now is having its products manufactured under contract, and plans ultimately to equip a plant and do its own manufacturing. Officers are: President, R. J. Tector; vice president, E. L. Howe, and secretary-treasurer, Andrew Wierengo. The office of the firm is at 309 Union Bank building, Muskegon.

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Contents

Specialist Should Rig Patterns

THERE are many slants to making castings and the omission of one essential may hinder seriously the success of the entire cycle of operations. To secure good castings, the metal must be of a certain composition and the molds must be correctly gated and made of the proper grade of sand. Further, to secure economical production, patterns must be rigged in the most efficient manner. Not every foundryman is qualified to do this, therefore the final decision on rigging should devolve upon someone who has proved his ability. No matter how brilliant nor accomplished no one can rig patterns so that no improvement is possible. Therefore, every assistance should be available to the one responsible for this work. After the rigger has decided on the method he thinks best for molding the casting, the foreman on the floor on which the casting is made should be called in to discuss the rigging. He is closer to the operating end than the one who has designed the rigging and through his personal experience may have pertinent suggestions of value. At this time the foreman will have opportunity to criticize, and if he has no suggestions, it is taken that he concurs in the judgment of the designer. He then has no excuse for not producing the rated number of castings. At the conference between the foreman and the designer of the rigging, the proper grade of workman to put on the job also may be decided. Possibly the foreman has no molder to put on the job, then alterations must be made to enable a laborer to make the mold, or other points may be shown by the foreman which make the method of rigging impractical as designed. This form of organization, in operation in many foundries, utilizes the ability of the highly trained expert and modifies it with the practical experience of the molding foreman.

Malleable Shops Increase Capacity

READJUSTMENT after the war has brought about a marked demand for malleable castings. This has been so pronounced that the malleable shops in operation at capacity immediately after the armistice were unable to handle the great volume of work which came to them and there was a decided increase in the number of new plants erected. Previous to 1919 there had been relatively little new construction in the malleable field, and the gain in capacity of the malleable iron shops was comparatively small from year to year. However, within the past 18 months there has been built, or started, enough new construction to increase the capacity of the malleable-iron foundries in the country by from 25 to 33 1/3 per cent. Some of this new development was started by manufacturing plants which found it almost impossible to secure the necessary castings, while a large proportion of it was furnished by established foundry companies which increased their plants or built new ones. Most of the increased business which came to malleable foundries was due to the greatly augmented demand for automobile castings. The capacity is now becoming large enough to handle this work promptly but a revival in the demand for railroad castings is expected to again overtax malleable foundries. However, the slacking of demand for automobile castings which is at present in evidence will allow the filling of quite a large demand from the railroads.

Trade Outlook in the Foundry Industry

FUTURE price trends in foundry basic raw materials are the source of much interested speculation at the present time. The railway rate advance which becomes effective this week is the strongest factor upon which a probable rise in price levels is forecasted. Opposing this tendency is the force of receding demand for manufactured materials which is evident in many lines. Slowing down in the general buying movement, which reached a peak in the early summer, may serve as an effective brake upon any radical upward movement in coke, scrap, pig iron and other commodities. Although pessimism is absent, conservatism is dictating greater care in manufacturing schedules in practically all lines.

Iron Prices in Doubt

A wide divergence in prices on pig iron produced in the different districts is expected to result when the new freight rates are in effect. The balance will be slightly in favor of those furnaces which are located along the Great Lakes where ore may be delivered without an added cost of rail transportation and where coke and limestone are close at hand. It is stated that eastern furnaces will face an increase of about $2.50 a ton on raw materials, while in the Youngstown district the increase will be about $1.50 to $1.60 a ton. Southern furnaces will be at a marked disadvantage in the transportation of their finished product to many foundry centers. The gains made by southern ironmakers during the war and the period following probably will be decreased, particularly if the demand for castings falls off during the next few months. No slackening in demand for southern iron has been apparent up to the present time, the inquiry for first quarter 1921 delivery having been in excess of the tonnages which makers are willing to contract at present prices. Diffidence has been shown by producers and consumers alike in contracting iron for the coming year, pending the effects of the various factors now being brought to bear on prices.

Prices of Raw Materials for Foundry Use

CORRECTED TO AUG. 24

Iron		Scrap	
No. 2 foundry, valley	$47.00 to 50.00	Heavy melting steel, Valley	$27.50 to 27.75
No. 2 Southern, Birmingham	42.00 to 45.00	Heavy melting steel, Pittsburgh	29.00 to 29.50
No. 2 Foundry, Chicago	48.00 to 50.00	Heavy melting steel, Chicago	25.50 to 26.00
No 2 Foundry, Philadelphia	50.90 to 52.05	Stove plate, Chicago	32.00 to 32.50
Basic, Valley	48.50	No. 1 cast, Chicago	42.00 to 42.50
Malleable, Chicago	46.50	No. 1 cast, Philadelphia	39.00 to 41.00
Malleable, Buffalo	51.25	No. 1 cast, Birmingham	33.00 to 35.00
Coke		Car wheels, iron, Pittsburgh	45.00 to 46.00
		Car wheels, iron, Chicago	39.00 to 39.50
Connellsville foundry coke	$18.00 to 19.00	Railroad malleable, Chicago	32.50 to 33.00
Wise county foundry coke	18.50 to 20.00	Agricultural malleable, Chicago	33.00 to 33.50

No Recession in Castings

No immediate decline in castings prices is to be expected from present indications. It is evident that all those materials which enter into castings manufacture will show no immediate fall in price. Further, the freight increase undoubtedly will exert a strong influence. While labor is slightly more plentiful, and a greater efficiency is reported, the past quarter, according to accurate comparative figures has developed a still greater advance in the labor factor entering into finished casting costs. In one branch of the foundry industry, the second quarter of the present year has been marked by an increase of about 15 per cent in the labor cost on each ton of castings, as compared with the third quarter of 1919. Labor in this instance represents about 40 to 60 per cent of the entire cost of production. Fuel prices, although not so important in computing the price of foundry products, likely will become a source of greater concern as the winter advances. Steel foundries melting in electric furnaces report an advance in power delivery charges throughout the country where utility corporations are obliged to meet higher prices on fuel.

Demand Is Weaker

Although gray iron and malleable shops in general continue to have ample orders, but little new inquiry is evident. Starting with the automotive industries, where retrenchment has been the rule for the past month or six weeks, a slackening of demand is noted. Although there has been only a few actual cancellations, the volume of new inquiry has fallen off to a degree that has permitted car manufacturers to place orders for new business readily, while during the early summer it was almost impossible to secure shop facilities for furnishing many cast parts which enter into automobile and truck manufacture. Malleable and gray iron shops alike which make castings for the automotive industries still have sufficient business to maintain full operation, and although new inquiries are practically absent, and deferred deliveries are requested in some instances, these foundries are making no effort to solicit business from other than the automotive industries. Prices paid for automobile castings are attractive, the equipment and facilities of these shops are best adapted to this class of work and almost without exception, they are optimistic in predicting an early return of heavy requirements from the automobile builders. Malleable and steel foundries which are engaged on railroad work have all that they can do in meeting the demand for repair and replacement parts. The call for castings from the railroads is so strong that some shops are endeavoring to sublet contracts in excess of their facilities. Little new car business is offered. Whether this is from a canny desire to prevent bulling the market or whether the improvement in transportation may serve to cut down the estimated requirements for new equipment is not apparent at this time. Agricultural implement makers sufficient orders to last through several months, and those making castings for building construction have noted a slight increase in inquiries. Prices of nonferrous metals based on New York quotations of Aug. 25 follow: Copper, 18.00c to 18.12½c; lead, 9.25c to 9.32½c; Straits tin, 45.50c; antimony, 7.00c to 7.25c; aluminum No. 12 alloy, producers' price, 34.00c and open market, 29.00c. Zinc is quoted at 8.05c to 8.40c, East St. Louis.

Comings and Goings of Foundrymen

JAMES A. MURPHY, who recently resigned the position of foundry superintendent of the Hooven-Owens-Rentschler Co., Hamilton, O., has been made president and general manager of the Connersville Foundry Co., Connersville, Ind. Mr. Murphy is widely known throughout the foundry industry. During the past 20 years he has had charge successively of the Ball Engine Co., Erie, Pa.; the Chicago Pneumatic Tool Co., Franklin, Pa; and the Interstate Foundry Co., Cleveland. For the past 13½ years he has been superintendent of the Hooven-Owens-Rentschler foundry in Hamilton, O. Always a close student of foundry problems and of pioneering disposition, he introduced many innovations in the casting industry which today are regarded as standard practice. Stringless wax vents for venting thin and difficult cores, skimming and spraying devices, ingenious flask construction and rigging for casting large work, particularly large fly wheels, molded above the floor, furnish examples of his varied accomplishments. His phenomenal record in turning out the castings for over three hundred 2800-horsepower engines for the Emergency Fleet corporation at the rate of 10 complete engines a week, probably will be unexcelled for some time to come. In addition to his foundry activities, Mr. Murphy always has taken an exceedingly active part in the community life of the city. During the war he organized and captained a full company of home guards.

W. R. Clark has been appointed superintendent of the Automotive Castings Co., Imlay City, Mich.

L. W. Hewitt has been appointed general manager of the Specialty Brass Co., Kenocha, Wis.

B. T. Bacon retired recently after serving Pickands, Brown & Co., Chicago, pig iron dealers, as sales agent for 36 years.

H. D. Balsinger, has resigned as a superintendent in the American Steel Foundries to accept the assistant superintendency of the T. H. Symington Co., of Rochester, N. Y.

R. L. Favor has resigned as foundry foreman, Charleston navy yards to accept a similar position with the Emery Steel Castings Co., Baltimore.

J. F. Hunter, who has been acting general sales agent of the Virginia Iron, Coal & Coke Co., Roanoke, Va., has been appointed general sales agent, effective Aug. 1.

Arthur Corbeille has been appointed manager of the W. L. McCullough Foundry Co., Ypsilanti, Mich.

Fred A. Blackston, has been elected vice president and treasurer of the Eagle Iron Works, Muskegon, Mich., Mr. Blackston was formally an official of the Linderman Steel & Machine Co.

George J Martin has been made assistant superintendent of the Aetna

JAMES A. MURPHY

Foundry & Machine Co., Warren, O., having previously been chief engineer of the same company.

Edgar M. Lewis, formerly connected with the E. J. Woodison Co., Detroit, recently has become associated with the J. S. McCormick Co., Pittsburgh, makers of foundry supplies.

W. C. Hamilton, formerly works manager of the American Steel Foundries, Granite City, Ill., has been appointed works manager of the Duquesne Steel Foundry Co., Coraopolis, Pa.

A. C. Porter has resigned the position of foundry superintendent with the Cushman Motor Works, Lincoln, Nebr., to accept a similar position with the Witte Engine Works, Kansas City, Mo. Mr. Porter is a graduate of Wentworth institute, Boston, where he made a special study of metallurgy, production efficiency, and foundry chemistry.

Fred E. Smith has resigned his connection with Philip E. Wright, Stephen Girard building, Philadelphia, to become associated with Carson & Co., Pennsylvania building, that city, dealers in pig iron, coal, coke and ferroalloys.

James A. Carey, formerly Pittsburgh resident manager for the Hill & Griffith Co., has entered business for himself and is handling a general line of foundry facings, supplies and equipment, with offices in the Fulton building, Pittsburgh.

W. J. Jones, works manager of the J. I. Case Plow Works Co., Racine, Wis., has been elected a vice president of the company in charge of production. Mr. Jones has been affiliated with the company only about one year.

Frederick A. Pelton, an assistant cashier of the Northampton National bank, Northampton, Mass., has resigned to take effect Sept. 1, when he will become assistant treasurer of the Haydenville Co., Haydenville, Mass., maker of brass and iron goods.

Robert H. Irons, president of the Central Iron & Steel Co., and Ross A. Hicok, treasurer of the W. O Hicok Co., Harrisburg, Pa., have been named members of the representative council at the Harrisburg offices of the Pennsylvania state employment service.

K. V. Wheeler has recently resigned as superintendent of the Electric Steel Co., Chicago, to become general manager of the Lebanon Steel Foundry, Lebanon, Pa. Prior to the war Mr. Wheeler was with the Dominion Steel Foundry Co., Hamilton, Ont., Can., and from there went to the Zimmerman Steel Co., Bettendorf, Iowa, where he for some time served in the capacity as superintendent.

Plan National Engineering Society

The joint conference committee of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers has sent invitations to approximately 150 leading engineering societies in the United States, asking them to appoint

delegates to a meeting to be held next fall for the purpose of forming a national engineering organization. The proposed organization will be known as the Federated American Engineering societies and will have a prospective membership of 225,000 in all lines of engineering. The executive body will be known as the American Engineering council, representation in which will be granted to the component organization. While details have not been definitely decided, it is expected the council will be ready to succeed the existing engineering council, organized for war work in June, 1917, when the original council goes out of existence.

Will Study Material Handling Methods

The American Society of Mechanical Engineers, has formed a materials handling section whose object is to "promote the art of the mechanical handling of all materials."

The first meeting of this section was held at the Engineering Societies building, 29 West Thirty-ninth street, New York, Aug. 13. Robert M. Gates, managing engineer specializing in material handling equipment, Lakewood Engineering Co., Cleveland, presided. In his address Mr. Gates emphasized the fact that the section must be a bureau of information—complete in its scope, specific in its knowledge of the physical and economic conditions, and unbiased in its conclusions.

Steel Treaters to Meet

The annual convention of the American Steel Treater's association and the Steel Treating Research society will be held in Philadelphia, Sept. 14-18. Besides the long program of technical papers dealing with all phases of heat treatment a display of heat treating equipment will be given by more than 125 exhibitors. The date of this convention will give the exhibitors ample time to ship their exhibits to Columbus, O., for the foundrymen's convention. An extensive entertainment program is being arranged for the members and guests in attendance.

Welding Society Forms Pittsburgh Section

The American Welding society organized a Pittsburgh section Thursday afternoon, Aug. 12. The officers elected were: Chairman, J. D. Conway; first vice chairman, Dr. R. H. Brownlee; second vice chairman, H. H. Maxfield; temporary secretary, F. W. Tupper, and treasurer, F. O. Gardener. The members of the executive committee are: W. M. Finlayson, G. H. Danforth, J. A. Warfel, F. C. Satterley, A. M. Candy, H. D. Kelley, D. J. Ridding, C. H. Newbury, Carles Crates, F. S. Austin, J. H. Rush and B. P. McDaniel

The first open meeting of the new section was held in the evening at the chamber of commerce auditorium. At this meeting a number of short papers were presented. W. R. Hulbert, the Metal & Thermit Corp., New York, presented a paper describing the repair of the stern frame of the army transport, NORTHERN PACIFIC, by means of thermit. This paper was illustrated with moving pictures. Douglas F. Miner, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., told

CHARLES J. WILTSHIRE

of recent developments in percussion welding. Gas cutting methods were described by C. J. Nyquist, C. J. Nyquist Co., Cleveland.

J. H. Deppeler, president of the welding society, spoke of the general organization of the society and said that the Pittsburgh section was the third to be organized, sections having been formed in Philadelphia and New York. Other sections will be established in different parts of the country, Mr. Deppler said. He called attention to the work of the American Bureau of Welding which is controlled by the American Welding society in conjunction with representatives from a large number of other technical societies. This bureau is a research organization which calls on the industry directly interested in any particular line of work which it undertakes, for financial assistance. The results of the research are then given out for the benefit of those interested in welding. This branch of work is comparatively new and considerable development is anticipated in the future. So far little success has been made in cutting gray iron with a gas flame, but Mr. Nyquist stated that he thought a practical method for doing this would soon be perfected.

Charles J. Wiltshire Is Killed in Accident

Charles J. Wiltshire for the past 13 years superintendent of the iron foundry department of the Schenectady works of the General Electric Co., Schenectady, N. Y., was killed in his automobile on July 19, when it was struck by an interurban car.

Mr. Wiltshire was born in Ealing, now a part of London, England, Aug. 2, 1862, and came to the United States with his parents when about 10 years old. The family located at Chicago. His first employment was that of an errand boy for Marshall Field & Co., but later he was apprenticed as a molder and subsequently secured training in the office routine of foundry operations. He spent a short time in foundries on the Pacific coast in 1892 and subsequently was employed at Providence, R. I., and Chester, Pa., in steel and brass as well as foundry work. For a while he was in charge of the brass foundry of the National Cash Register Co., Dayton, O. About 1894, he returned to Chicago and was placed in charge of the iron foundry operated by the Gates Iron Works of that city. After several years affiliation with the Gates Iron Works, he served as foreman of the iron foundry of the Pullman Co., Pullman, Ill., and of the foundry of the Western Electric Co., Chicago. In 1907 he was appointed superintendent of the iron foundry of the General Electric Co. and had charge of the iron and steel casting production. The position he held at the time of his death. In his work with this company he was closely identified with the work of developing the electric steel casting process.

Mr. Wiltshire was a member of the American Foundrymen's association and was a member of the committee on general specifications for gray iron castings to co-operate with the American Society for Testing Materials.

John M. Glass, formerly with the Hill & Griffith Co. Cincinnati, has incorporated a company known as the John M. Glass Co., Indianapolis, Ind. Associated with him is L. A. Daly, also formerly connected with the Hill & Griffith Co.

Truck Wheels Stronger Than Necessary

Radial-compression and side-thrust tests were made on a large number of motor-truck wheels, using the Emery hydraulic testing machine at the bureau of standards. This large machine has a capacity of 2,300,000 pounds. For the radial-compression tests the wheel was placed on a short axle supported on both sides of the wheel by bearing blocks. Load was then applied through a block at the rim. This block distributed the load over the full width of the rim and along an arc of 6 inches. The wheel was placed so that the load was applied to a section of the rim between spokes.

In the side-thrust test the load was applied to the side of the rim of the wheel through a block 6 inches wide. The wheel was so placed that the point of application of load was between spokes and approximately 90 degrees from the point at which the stress had been applied in the radial-compression test. In this test the wheels were loaded to destruction.

These laboratory tests were not intended to supplant service tests, but the bureau of standards concludes that much information can be obtained in the laboratory which could not be obtained by service tests within a reasonable length of time. Defects in design and material are soon made apparent in laboratory tests and changes can be made before wheels are manufactured in large quantities.

The wheels tested were representative of those used on 3 and 5-ton trucks, and it is quite improbable that any of these wheels would ever be stressed even to its proportional limit.

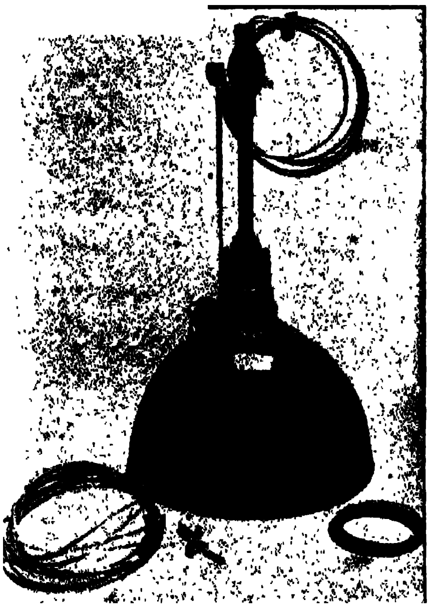
The wheels tested are all stronger and heavier than is necessary, and a saving in material should be effected.

A reduction in weight is worthy of consideration, not only because of the material saved, but also because it would result in an increase in the life of tires and of roads.

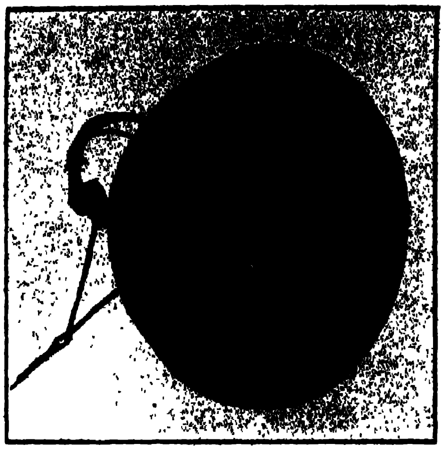
A description of the tests with curves showing all the information obtained from tests on each wheel are given in technological paper No. 150 of the bureau of standards.

Light Fixtures Cleaned Automatically

Dust in the foundry soon covers any lighting equipment and reduces its efficiency making frequent cleaning necessary to secure satisfactory results. In

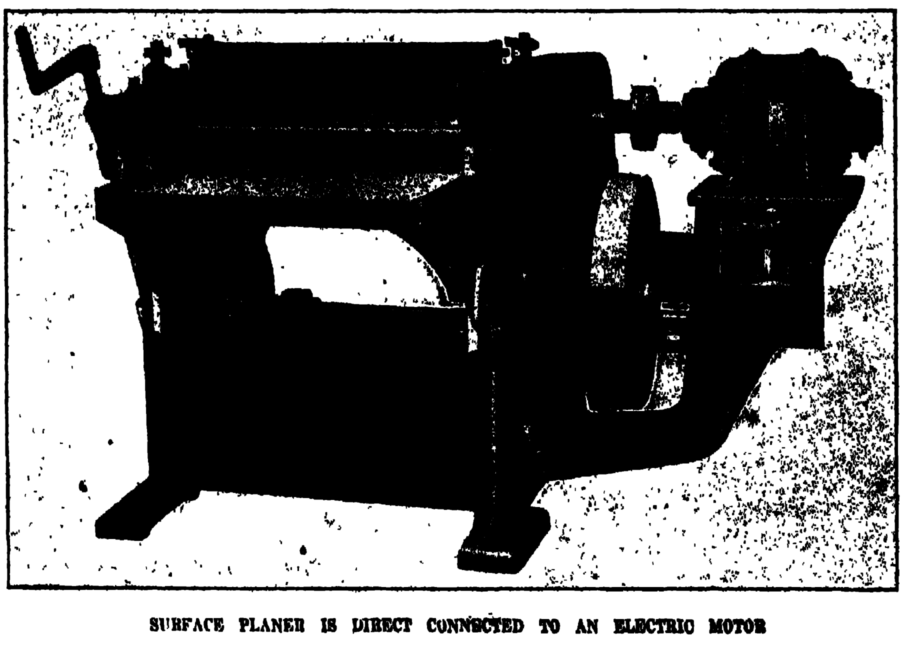


PULLING THE CORD WHICH OPERATES THE SWITCH ALSO REVOLVES THE WIPING BLADES



WIPING BLADES CLEAN THE LAMP AND THE REFLECTOR

order to reduce lighting maintainance charges the Associated Engineers Co., Chicago, has put on the market a device which cleans the lamp and shade each time the light is turned on or off. This device, as shown in the two accompanying illustrations consists of two wiping blades; one rotates against the interior of the reflector, and one against the lamp bulb. As the stem switch is pulled, these two blades come into action, sweeping the dirt off both lamp and reflector by a complete revolution. The blades never reverse. Such frequent cleaning does not allow dirt to cake on the reflector, and the accumulation of a few hours is not sufficient to annoy workmen in dropping down on the work below. The tendency is rather for the finely divided dirt to float away.



SURFACE PLANER IS DIRECT CONNECTED TO AN ELECTRIC MOTOR

Surfacer Changed to Motor Drive

The Oliver Machinery Co., Grand Rapids, Mich., has designed its surface planer for direct motor drive. It is driven by a standard 3600-revolutions-per-minute motor coupled to the cutting cylinder. Thus belts are no longer needed. In order to secure the proper number of cuts per minute three high-speed cutting knives are supplied in the cutting head. Having the motor drive, it is not necessary to set the planer in any special place to line up with shafting. The surfacer is self contained and so considerable saving of room is effected over the former belt-driven machine.

Outlines Carbon Case

Dealing with the strage, use and handling of carbon electrodes the National Carbon Co., New York, has recently completed a booklet intended for those interested in electric furnace operation. In the preface is a history of electric furnaces from the

time in 1878 when W. Siemens designed and built a furnace, until the present time. It explains also how the by-products calcium carbide, artificial abrasives, aluminum, ferroalloys and phosphorus have been made possible by electric furnaces. According to the booklet the electrodes should have such characteristics as low electrical resistance, low heat and high conductivity. Care should be exercised in handling electrodes especially in unloading from cars as this often causes defects detrimental to efficient operation.

Among the principles embodied in joining electrodes is the use of a "joint" compound to fill the space between and insure continuous contact. This compound should be plastic and adhesive but of such consistency that it will not melt out when the electrodes become heated. Details of connecting, taken up in the publication, include such principles as applying the compound, adjusting the connecting pin, picking up the electrodes, and screwing them together. When unwarranted oxidation occurs, under the furnace roof, it is known as *spindling* and to insure minimum electrode consumption this must be eliminated. The causes of this together with those incident to *wasping* and the most important factors in securing minimum oxidation of electrode are made clear in the booklet. Logs and records used in connection with furnace operation are advocated by the company manufacturing carbons.

Tables of data for both round and square electrodes conclude the publication. These contain information as follows: sizes, areas, current carrying capacities formulas for deducting the data and a bibliography of books and articles incident to the subject of carbon electrodes.

The McMyler Interstate Co., of Warren, pioneer in the manufacture of castings, etc., in Warren, has been sold to interests connected with the Brier Hill Steel Co. Since Aug. 1 it is known as the Eastern Ohio Steel Co. Charles Lewis, sales manager of the Sykes Metal Lath Co., of Niles, is manager of the new company.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The Marengo Foundry & Machine Co., Marengo, Ill., has opened an addition to its plant.

A building, 60 x 75 feet, will be erected by the Hercules Steel Casting Co., Milwaukee.

The National Brake & Electric Co., Milwaukee, plans the erection of a foundry, 160 x 180 feet.

Erection of a pattern storage building is being planned by the Watson-Stillman Co., Aldene, N. J.

The Howell Foundry, Howell, Mich., plans the erection of a plant.

Erection of a foundry building, 56 x 100 feet, is planned by the Hamburg Foundry Co., Hamburg, Pa.

The Galesburg Foundry & Casting Co., Galesburg, Mich., has changed its name to the Battle Creek Jobbing Foundry Co.

Plans have been prepared by the A. Garrison Foundry Co., Ninth and Bingham streets, Pittsburgh, for the erection of a plant addition, 200 x 240 feet.

The Kokomo Malleable Iron Co, Kokomo, Ind., has increased its capital stock from $350,000 to $500,000.

The Silver Iron & Steel Co., Greenville, O., shortly will start work on the erection of a foundry, 100 x 200 feet.

The United Machine & Mfg. Co., Akron, O., has had plans prepared for the erection of a new foundry, 100 x 200 feet.

Erection of an addition to its foundry, 110 x 118 feet, is being planned by the Excelsior Machine & Tool Co., East St. Louis, Ill.

The Lake Erie Foundry Co., 218 C[illegible]go street, Buffalo, plans the erection of a foundry, 37 x 82 feet.

Capitalized at $20,000, the Superior Castings Co., Dayton, O., has been incorporated by R. F. Shields, W. Hicks, A. W. Newman, and others.

The capital stock of the James Leffel Co., Springfield, O., recently was increased from $750,000 to $1,750,000.

The capital stock of the Chambersburg Foundry Co., Chambersburg, Pa., has been increased from $5000 to $132,000.

The capital stock of the Werner G. Smith Co., Cleveland, recently was increased from $750,000 to $1,500,000.

The Salem Foundry & Machine Corp., Roanoke, Va., is said to have under consideration, plans for the erection of a foundry and machine shop.

Capitalized at $5000, the Enterprise Brass Foundry, Inc., Boston, recently was chartered by William S. Rendle, 52 Porter street, Melrose, Mass., and others.

The plant of the Steigler & Kerr Stove & Foundry Co., 2201 Folsom street, San Francisco, recently was damaged by fire.

Work on the erection of a new plant for the Cooper Brass Works, Ogdensburg, N. Y, is rapidly nearing completion.

The Wheeling Axle Co., Wheeling, W. Va., which was recently organized, has arranged for the erection of a building to be used as a foundry.

The A. E. Martin Foundry & Machine Co., 705 Clark street, Milwaukee, plans the erection of an addition to its foundry, 30 x 145 feet.

The Detroit Motor Castings Co., Detroit, has placed an addition to its plant in operation. It is 75 x 125 feet.

Capitalized at $75,000, the New Haven Foundry Co., New Haven, Mich., recently was incorporated by F. J. McCracken and others

Erection of an addition to its foundry, 30 x 100 feet, is planned by the Beans Foundry Co., Martins Ferry, O.

The Fox River Tractor Co., Appleton, Wis., is erecting a plant addition, 40 x 75 feet, and later will erect a machine shop and gray iron foundry.

The Traction Steel Castings Co., East La Porte, Ind., which recently purchased a site for a plant, will start work shortly on the erection of the structures.

Operations in its gray iron foundry will be started about Sept. 10 by the Newman Foundry, Kendallville, Ind. It will turn out light and medium jobbing work.

The Charles H. Miller Foundry Co., Chicago, has bought a site on which it plans the erection of a foundry, 100 x 200 feet. It is said the company's present plant will be sold.

Capitalized at $100,000 the Palmyra Foundry Co., Palmyra, N. J., recently was incorporated by G. C. S. Weisel, L. F. Thum and John T. Mercer, to manufacture iron and steel castings, etc.

It is reported the Ware Foundry Co., Ware, Mass., is planning to increase its capital stock to $50,000, part of the increase to be used in financing

Capitalized at $50,000, the Sward Foundry & Machine Co., recently was incorporated with headquarters at Youngstown, O., by J. Adams, G. Winkelholz, T. Donofrio, W. T. Richards and J.

Plans have been completed by the Union Mfg. Co., New Britain, Conn., for the erection of a building, 49 x 51 feet. The company manufactures gray iron castings, etc.

The Simple Gas Engine Works, Menasha, Wis., has tentative plans for the erection of an addition to its foundry and core room, to be 60 x 100 feet. F. J. Oberweiser is president and general manager.

The capital stock of the Roberts Brass Co., 178 Lincoln avenue, Milwaukee, manufacturer of brass castings and small brass specialties, recently was increased from $15,000 to $50,000.

Erection of a new plant, 40 x 125 feet, is being planned by the Shreveport Brass Works, Shreveport, La. It is proposed to install a large amount of new equipment. R. J. Morton is manager.

The Princeton Foundry & Supply Co., Princeton, W. Va., has been incorporated with a capital stock of $50,000, by L. E. White, G. H. Crumpecker and C. W. Hall.

The Central Malleable Castings Co, Franklin Park, Ill., has bought the plant of the Northwestern Steel Corp. and will equip and use it as a malleable gray iron foundry. Charles Drozeski is president.

The Rochester Casting Corp., Rochester, N. Y., has been incorporated to carry on business with an active capital stock of $1,050,000, by C. F. Wray, A. N. Wright and L. O. Graves.

Capitalized at $100,000, the Mt. Holly Foundry Co., recently was incorporated in Delaware, by Lewis R. Palmer, George C. Palmer, Ridley Park, Pa., and John F. Malloy, Wilmington, Del.

The Jorgenson Mfg. Co., Waupaca, Wis., will build a brass foundry and is having plans prepared for the erection of an addition to its hydro-electric power plant.

The Detroit Valve & Fittings Co. and the Detroit Brass Works, Detroit, which were recently merged, will be operated under the name of the Detroit Brass & Malleable Works.

Work has been started on the erection of a 1-story, 35 x 200-foot machine shop, a 50 x 100-foot foundry and a 40 x 100-foot pattern shop, for the National Woodworking Machine Co., Dover, N. H.

The Ruud Mfg. Co., Twenty-ninth and Smallman streets, Pittsburgh, is having plans prepared for the erection of a plant addition to be used as an

extension to the foundry and machine shop. Edward Rudd is president of the company.

The Jamestown Malleable Iron Products Co., Jamestown, N. Y., has had plans drawn for the erection of a foundry, 260 x 300 feet.

The Valley Falls Foundry & Machine Co., Cumberland, R. I., has been incorporated with a capital stock of $150,000, by John F. Murphy, West Warwick, R. I.; Fred A. Tobin, East Providence, R. I., and Joseph F. McSoivey.

The American Malleable Iron Corp., Lynchburg, Va., which was recently incorporated in Delaware with a capital stock of $1,000,000, has acquired a site on which it plans the immediate erection of a plant.

An aluminum and brass foundry has been established at 2137 Blue Island avenue, Chicago, under the name of the National Aluminum & Brass Foundry, by Victor S Kucki and Frank T. Luka. Jobbing work in aluminum, brass and bronze will be done.

The Claus Automatic Gas Cock Co, Milwaukee, has announced that it shortly will erect a brass foundry to contain approximately 15,000 square feet The company is interested in all of the latest labor saving, tumbling, melting and metal carrying devices now on the market

Bids will be taken by the Worthington Pump & Machinery Corp. for the erection of a 4-story pattern shop and extension to the pattern storage vault, at the company's branch plant at Cudahy, Wis, which is known as the Power & Mining Machinery Co and the International Gas Engine Co. The building will be 60 x 180 feet.

Capitalized at $60,000 the Hall Foundry & Machine Co, Inc., Jacksonville, Tex, is conducting a general foundry and machine shop business It possibly will later on engage in some manufacturing in the new building, which now is being erected. All machinery needs have been contracted for. Sam J Hall is president, R I. Weir is secretary and treasurer and F. L. Haberle is vice president.

Organized for the purpose of making malleable castings, the Ashland Malleable Co., Ashland, O., expects to have a foundry built before Jan. 1 It is capitalized at $150,000, and will be in the market for all sorts of foundry equipment. Officers of the company are: President, J. H Firestone; vice president, Samuel Miller; treasurer, E. M Armstrong, and secretary, W. L Rybolt

Two 10-ton cranes, built by the Milwaukee Crane & Mfg Co., Milwaukee, recently were purchased by the Valley Iron Works Co, Appleton, Wis, which has equipped a foundry and manufacturing building, to be devoted to the manufacture of machinery for paper and pulp mills. The foundry is 40 x 120 feet and the manufacturing building, 42 x 140 feet E. A. Paterson is general manager and W H. Burns is assistant manager.

To engage in the manufacture and machining of gray iron castings, the Decatur Castings Co., Hamilton, O., recently was organized by interests connected with the Hamilton Foundry & Machine Co., Hamilton, O It is capitalized at $400,000 and it has a plant at Decatur, Ill., which is fully equipped and now in operation. Officers of the company are: President, Gordon S. Rentschler; vice president, G. A Rentschler; secretary and treasurer, H. A. Rentschler and general manager, D. McDaniel.

The Pioneer Brass Works, Indianapolis, is erecting a foundry building, 150 x 200 feet, which will include a molding room, furnace room, core room and grinding room. The structure will be of brick and steel construction. From 35 to 50 additional molders' benches, several large type roll-over jolt molding machines and some additional squeezers will be needed in the way of new equipment. J. H. Brinkmeyer, is president and Carl W. Piel is secretary of the company.

Construction has been completed of a plant for the Shea Bronze Casting Co., 232 Fifth street, Bridgeport, Conn., and work will start in the new building as soon as all necessary equipment has been installed. The company is now in the market for a small core oven, 12 x 18 feet, a steel or iron flask tumbling barrel, sprue cutter, three horsepower motor and grinder, and small tools and supplies. J. F. Shea is one of the officers of the company.

Contracts have been let by the Colonial Foundry Co., Louisville, O., manufacturer of semisteel castings, for the erection of an addition to its foundry. The building will be 60 x 160 feet, of structural steel construction, and will be equipped with a 15-ton electric crane, a 72-inch cupola and an electric blower. When completed castings up to 25 tons will be turned out. The Alliance Structural Steel Co. has the contract to build the structure, while the Alliance Machine Co. will furnish the crane and the J. S. McCormick Co., the cupola and blower. It is expected the structure will be ready for occupation about Dec. 1. C. A. Jackson is general manager of the company.

New Trade Publications

MELTING POTS.—The Cutler-Hammer Mfg. Co., Milwaukee, recently issued a 2-page leaflet, in which metal melting pots, both portable and bench types, are described and illustrated. These pots are said to be especially serviceable for melting lead, tin, solder, babbitt, etc., the claim being that the proper temperature is at all times retained. Heat is controlled by means of a rotary snap switch or an automatic control device, so that the desired temperature can always be had. The illustrations show a bench-type pot mounted on a hand truck and a portable pot, the latter being made in sizes ranging from 10 to 25 pounds.

PNEUMATIC TOOLS The Independent Pneumatic Tool Co, Chicago, has published a 78-page illustrated catalog in which it describes and illustrates pneumatic tools and electric drills which it manufactures. New additions to the company's line of products, which are described in this catalog, include, motor-driven air hoists, pneumatic sand rammers, universal vice for pneumatic drills; hose couplings; power screw driver, hose clamp and hose mender.

WELDING AND CUTTING.—The Oxweld Acetylene Co, Chicago, has issued a series of small printed pamphlets containing information of value to users of welding and cutting apparatus. The matter contained in the pamphlets was taken from the company's instruction book and catalog, and among the subjects are: Directions for operating lead burning equipment, and directions for operating welding equipment and directions for operating cutting equipment Each pamphlet contains a detailed list of parts comprising the equipment treated

FLANGED FITTINGS—The Lynchburg Foundry Co., Lynchburg, Va., has issued its 1920 edition of its cast iron flanged pipe and fittings catalog. In this booklet the company has endeavored to compile as much data pertaining to flange piping material as possible Lengthy and confusing details have been left out, it being understood that such details will be furnished upon request. The fittings described and listed in the catalog are made to conform to the American standard as recommended by the American Society of Mechanical Engineers.

HOLE DRILLS.—The Detroit Hexagon Drill Co., Detroit, has published an 18-page booklet in which angular hole drilling by the use of hexagon drills is described and illustrated. According to the booklet it is possible to drill a square or hexagon hole with the use of a hexagon drill, with no more trouble than that experienced in the drilling of round holes. The claim is made that to sink a blind hexagon or square hole ½ inch across the flats and 2 inches deep, without the use of a hexagon drill would require three hours work of a good mechanic, but that a similar job can be done in about six minutes, by using a hexagon drill, and the work will not be out more than .005 of an inch in any respect.

BEVEL GEAR GENERATOR.—An illustrated 4-page circular is being circulated by the Bilgrim Machine Works, Philadelphia, in which two sizes of bevel gear generators are described and illustrated. The first size will plane bevel wheels up to six inches in diameter with 1 inch pitch and 2½ inches face from mitre wheels to bevel wheels of proportion one to six. This machine occupies a floor space of 3-feet, 10-inches x 2-feet, 3-inches, while its gross weight is 2700 pounds. The other size described, will plane bevel wheels up to 16 inches in diameter, 2 inches pitch, 6 inches face from mitre wheels to bevel wheels of proportion one to four. This type of machine occupies a floor space, 6-feet 1-inch x 2-feet 8-inches and its gross weight is 6100 pounds.

OPTICAL PYROMETER—The Rhode Laboratory Supply Co, New York, is circulating a 4-page leaflet in which an optical pyrometer for the measurement of high temperatures is described and illustrated. The instrument consists of a brass tube, furnished with a small achromatic telescope, so arranged that the objective of the telescope focuses the image of the heated body on a movable prism placed inside the tube. The eye-piece of the telescope then reveals the magnified image on the prism. A shield is provided to prevent exterior light reaching the eye The prism is made of specially prepared dark glass, which is so arranged that it cuts off the light emitted by a heated body at different temperatures. According to the leaflet the pyrometer can be used whenever the object to be examined shows a distinct coloration for any temperature above 525 degrees Cent

VERTICAL BORING MILL.—A 4-page illustrated folder has been published by the Gisholt Machine Co., Madison, Wis., in which a vertical boring and turning mill is described and illustrated. According to the folder, the driving mechanism is contained within the base of the machine and is driven by a 4-step cone pulley, which in connection with a 2-speed countershaft provides for 16 changes of table speeds in geometrical progression. The standard machine is equipped with a plain table. A foot brake enables the operator to have perfect control of the table after the power is thrown off. The turret head can be set at any angle within 30 degrees from vertical, either side of the center. Eight gear driven feeds are obtainable, and a micrometer index dial, reading in thousandths of an inch, facilitates the accurate setting of machine tools. Other details are given.

NEW OFFICES.—Rickard & Sloan, Inc., New York, have issued a booklet entitled "Trekking," in which the organization's new offices are described and in addition, a number of examples of the current advertising which it has done for its clients are shown. The booklet principally is devoted to describing the new offices, at 25 Spruce street, which have been laid out in such a way as to completely meet the needs of a high-class, specialized advertising business. The office is flooded with light from windows extending around three sides of the building. Noiseproof private offices are provided for the executives and creative staff. The arrangement of the general office is such as to enable an individual to be interviewed without disturbing others in the room. The photographic studio is complete. A line drawing, showing the layout of the various offices and departments is given, as is a line drawing of that part of New York City in which the offices are located. This shows the easy accessibility from street car lines, subway and railroad. A list of the organization's advertising clients are given, many of whom have been clients since the organization started business in 1912.

The FOUNDRY

Volume 48. No. 18
Whole No. 355

Published Semimonthly

CLEVELAND, OHIO, SEPTEMBER 15, 1920

All Ready for Columbus Convention

Excellence of Program and Unprecedented Scope of the Exhibition of Foundry Supplies and Equipment Promise Great Opportunity To Visiting Foundrymen—All Activities at State Fair Grounds

DURING the week of Oct. 4, Ohio will welcome the members of the American Foundrymen's association for the fifth time. On four previous occasions, twice at Cleveland and twice at Cincinnati has the state been host to this society which represents the foundry industry of the country. The choice of the capital city at this time was particularly fortunate. Situated as it is in the geographical center Columbus serves truly to represent the foundries of the entire state. Ohio at the completion of the most recent count still maintains a high standing with the total number of foundries within its borders. In 1918 there were 6444 foundries in the United States and Canada and of these 656 or more than 10 per cent were within the borders of that state, which ranked second only to Pennsylvania with a total of 806 active castings establishments.

A recently completed survey made by THE FOUNDRY indicates that there are a total of 689 foundries in Ohio, which again is second to Pennsylvania with its total of 888 shops. The importance of the state in this regard assures a record attendance at the convention from the foundries within the borders. Further, the location chosen is ideal to draw from the eastern and Mississippi valley regions wherein are situated most of the large foundry centers of the country.

Last year, when the convention was held in Philadelphia, many felt that a record attendance had been established which would not again be excelled. This may be true, but the interest evidenced throughout this country and abroad indicates that the Columbus gathering may equal if not surpass that held in the Quaker City, last year.

The state fair grounds at Columbus will serve to accommodate all of the activities of the convention. A group of seven buildings has been set aside, and work was started immediately upon the close of the state fair, Sept. 4, to prepare for the foundrymen. The registration offices and lecture rooms for the technical sessions will be established in the first of the group of buildings. A covered walk, leading from the street car shed at the entrance to the grounds, terminates at the entrance to this building. From the opposite end, similarly covered walks serve to connect the second, third and fourth, while beside these are the fifth, sixth and seventh buildings, respectively. This close grouping of all activities will serve to save a great deal of time to visitors, which last year was expended in going

from the meetings in down-town hotels to the exhibition at the Philadelphia Commercial Museums.

The great number of foreign visitors who last year visited the convention, it is thought, will be exceeded by this year's attendance from overseas. At a recent meeting of the Institution of British Foundrymen, held in Glasgow, keen interest was expressed in the approaching Columbus convention. At that time a desire was expressed to arrange an interchange of technical papers presented before the two societies in an effort to broaden the practical knowledge of the industry.

With more than 70 papers and committee reports on the tentative program, the technical sessions of the twenty-fifth annual meeting of the American Foundrymen's association, Inc., promises to surpass those of previous years in interest and value. In order that foundrymen can have an opportunity to hear more papers than was possible under the plan of holding three sessions at the same time, the program for the Columbus meeting has been arranged so that only two meetings are held simultaneously. Steel and nonferrous sessions will be held at the same hours Wednesday afternoon and Thursday morning, but all other meetings, with the possible exception of that scheduled for Friday morning, will be held separately. Under this plan, the necessity of dividing attention between two or three meetings is avoided.

Business Session Shifted

Another important change has been made by which it is hoped more time can be given to the annual business meeting. In past years attempts have been made to sandwich the transaction of business in between papers in technical sessions with the result that the meetings were prolonged to the point where the patience of members was sorely tried. This year the business session will be held Thursday evening at 8 o'clock, in connection with a "get-together" smoker. The annual address of the president and the reports of the board of directors and secretary-treasurer will be presented at this meeting. The annual banquet will be held Wednesday evening.

On account of the unusual interest evidenced in the subject of industrial relations at the Philadelphia convention last year, two sessions devoted to the subject have been arranged for this year. Many phases of the broad topic of industrial relationship will be discussed, including Americanism, training foundry executives, employment, vocational training, and relations between employers and their employes.

Another change introduced since last year's meeting involves the holding of joint sessions on the subject of nonferrous foundry practice with the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers. These joint meetings will be held Tuesday afternoon and Wednesday morning and will be marked by papers presented by the members of both organizations.

Condensed Program

Monday, Oct. 4

10.00 A. M. Registration, Building No 1, Ohio State Fair Grounds, Columbus, O.
10.00 A. M.—Opening of exhibition, Ohio State Fair Grounds.

Tuesday, Oct. 5

9:00 A. M. Exhibit opens and remains open until 10.00 p. m.
9.30 A. M. Gray iron and general session, lecture hall of Building No 1, Ohio State Fair grounds.
2.00 P. M.—Steel session, Building No. 1
2.00 P. M.—Nonferrous section session held jointly by the American Foundrymen's association and the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers, Building No 1.
8:00 P. M. Exhibit remains open until 10:00 p. m.

Wednesday, Oct. 6

9.00 A. M. Exhibit open until 5.00 p. m.
9.30 A. M.—Steel session, American Foundrymen's association, Building No. 1.
9:30 A. M.—Nonferrous section session held jointly by the American Foundrymen's association and the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers, Building No 1.
2.00 P. M.—Industrial relations session, American Foundrymen's association, Building No 1.
7:00 P. M.—Annual banquet.

Thursday, Oct. 7

7:00 P.M.—Annual banquet.
9:30 A. M.—Industrial relations session, American Foundrymen's association, Building No. 1.
1:00 P. M.—Special entertainment.
8:00 P. M.—Smoker at the Hotel Deshler, including business session, address by the president and reports of the officers.

Friday, Oct. 8

9.00 A. M.—Exhibit open until 5:00 p. m.
9:30 A. M.—Malleable session, American Foundrymen's association, Building No. 1.
9:30 A. M.—General session, American Foundrymen's association.

The metallurgical questions encountered in gray-iron foundry practice will be thoroughly discussed at the initial technical meeting, which will be held Tuesday morning, Oct. 5, at 10:30 a. m. Questions of sampling for analytical determinations, and of specifications covering gray iron will be given attention at this session. Two exceedingly interesting papers on the details of producing machine tool castings have been prepared by Leroy Sherwin, Brown & Sharp Mfg. Co., Providence, R. I., and A. N. Kelley, Cincinnati.

In the steel session to be held Wednesday morning, a great deal of attention will be given to the heat treatment of steel castings. Those who contributed papers on this subject include, E. F. Collins, General Electric Co., Schenectady, N. Y.; F. E. Brown, bureau of standards, Washington; Fred Grotts, Holt Mfg. Co., Peoria, Ill.; T. F. Baily, Electric Furnace Co., Alliance, O.; and C. H. Gale, Pressed Steel Car Co., McKees Rocks, Pa.

Live Malleable Session

The technical session on Friday morning, devoted to the subject of malleable iron, should prove of the greatest interest to all foundrymen, even though they are not directly interested in this phase of the industry. At this time the triplex process of making malleable iron will be presented in a paper by H. A. Schwartz, National Malleable Castings Co., Indianapolis. This will be the first complete and detailed description of this process which has been offered since the company first inaugurated this practice some three years ago. Other valuable papers on the subject of making malleable iron, fuel and fuel consumption and lining materials for furnaces and ovens will be given at this same meeting.

A great variety of interesting subjects will be covered in the final technical session which will be held Friday morning. At this time papers on welding will be given by A. S. Kinsey, Stevens Institute of Technology, Hoboken, N. J., and A. M. Candy, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Another important discussion at this session will deal with the question of testing molding sand. As is known to most foundrymen, there has been but little offered on this subject in the literature of the industry, and the paper by S. W. Stratton, bureau of standards, Washington, should do much to point the way in this important study. Other papers to be given at this time deal with the planning of equipment for foundries and the care of such equipment after it is in service. Some valuable points on foundry design and construction are contained in papers by James Brakes, Jr., Chicago, Frank D. Chase, Chicago, and Lieut. Col. H. C. Boyden, Portland Cement association, Chicago. Lieut. R. F. Nourse of the United

Program of Technical Sessions at Columbus

American Foundrymen's Association Group Meetings and Joint Sessions with the Institute of Metals Division, A. I. M. M. E.

Monday, Oct. 4

10:00 A. M.—Registration—Building No. 1, Ohio State Fair grounds.
10:00 A. M.—Opening of exhibition.

Tuesday, Oct. 5

10:30 A. M.—Technical Session—Gray Iron and General.

ZIRCONIUM IN CAST IRON, by Richard Moldenke, Watchung, N. J.

STANDARDIZING GRAY IRON SAMPLES FOR ANALYTICAL DETERMINATION, by Edward J. Fowler, Pacific Foundry Co., San Francisco.

A NOTE ON THE ELECTRIC FURNACE AND THE PROBLEM OF SULPHUR IN CAST IRON, by George K. Elliott, Lunkenheimer Co., Cincinnati.

PRODUCTION OF MILLING MACHINE TABLE CASTINGS, by Leroy Sherwin, Brown & Sharp Mfg. Co., Providence, R. I.

FOUNDRY METHODS AND EQUIPMENT FOR PRODUCING MACHINE TOOL CASTINGS, by A. N. Kelley, Cincinnati.

ELECTRICAL APPARATUS IN A MODERN IRON FOUNDRY, by F. D. Egan, Westinghouse Electric Mfg. Co., East Pittsburgh, Pa.

REPORT OF COMMITTEE ON GENERAL SPECIFICATIONS FOR GRAY IRON CASTINGS TO CO-OPERATE WITH A. S. T. M., by Richard Moldenke, Chairman, Watchung, N. J.

THE CONTROL OF METALLURGICAL OPERATIONS IN THE FOUNDRY, by H. L. Campbell, Industrial Works, Bay City, Mich.

Tuesday, Oct. 5

2:00 P. M.—Technical Session—Nonferrous Practice (Held jointly by Institute of Metals Division of A. I. M. M. E. and the American Foundrymen's association).

INVESTIGATION OF BRASS FOUNDRY FLUXES, by C. W. Hill, T. P. Thomas and W. B. Vlez.

LABORATORY TESTING OF SANDS, CORES AND COREBINDERS, by F. L. Wolf and A. A. Grubb.

THE RECLAMATION OF METAL FROM BRASS FOUNDRY REFUSE, by F. L. Wolf and J. E. Alderson.

A NEW PROCESS FOR MAKING 15 PER CENT PHOSPHOR COPPER, by P. E. Demmler.

RECENT DEVELOPMENTS IN DIE CASTING, by Charles Pack, Doehler Die Casting Co., Brooklyn, N. Y.

THE SOLUBILITY OF HYDROGEN IN MOLTEN COPPER AND COPPER ALLOYS, by C. W. Hill, T. P. Thomas and G. P. Luckey.

Tuesday, Oct. 5

2:00 P. M.—Technical Session—Steel.

OBTAINING MOLDING MATERIALS FOR THE STEEL FOUNDRY, by R. L. Lindstrom, Canadian Steel Foundries, Ltd., Montreal.

DESIRABILITY OF WORKING WITH PROSPECTIVE CUSTOMERS IN THE DESIGN OF CASTINGS, by K. W. Wheeler, Lebanon Steel Foundry, Lebanon, Pa.

METHODS OF HEADING AND GATING STEEL CASTINGS, by R. J. Doty, Sivyer Steel Casting Co., Milwaukee.

GATING, POURING AND FEEDING STEEL CASTINGS, by R. B. Farquhar, Electric Steel Co. of Indiana, Indianapolis.

REPORT OF COMMITTEE ON STEEL FOUNDRY STANDARDS, by W. A. Janssen, chairman, American Steel Foundries, Chicago.

REPORT OF COMMITTEE ON SPECIFICATIONS FOR STEEL CASTINGS TO CO-OPERATE WITH A. S. T. M., by R. A. Bull, chairman, Duquesne Steel Foundry Co., Coraopolis, Pa.

A NOVEL CORE OVEN, by Stephen B. Phelps, Jones & Laughlin Steel Co., Pittsburgh.

Wednesday, Oct. 6

9:30 A. M.—Technical Session—Nonferrous Practice (Held jointly by Institute of Metals Division of A. I. M. M. E. and the American Foundrymen's association).

CASTING LOSSES IN THE ALUMINUM FOUNDRY, by Robert J. Anderson, Bureau of Mines, Pittsburgh.

COKE AND BY-PRODUCTS AS FUELS FOR METALS MELTING, by F. W. Sperr Jr.

A NEW ELECTRIC FURNACE FOR MELTING BRASS, by C. H. Booth, Booth Electric Furnace Co., Chicago.

STATUS OF THE ELECTRIC FURNACE IN NONFERROUS INDUSTRY, by E. F. Cone, *The Iron Age*, New York.

PROBLEMS OF THE NONFERROUS FOUNDRY, by Russell R. Clarke.

Wednesday, Oct. 6

9:30 A. M.—Technical Session—Steel.

ANNEALING STEEL WITH PULVERIZED COAL, by C. H. Gale, Pressed Steel Car Co., McKees Rocks, Pa.

ACCURATE TREATMENT OF STEEL CASTINGS, by T. F. Baily, the Electric Furnace Co., Alliance, O.

HEAT TREATMENT OF STEEL, by F. E. Brown, U. S. Bureau of Standards, Washington.

ELECTRIC HEAT TREATING OF STEEL CASTINGS, by E. F. Collins, General Electric Co., Schenectady, N. Y.

HEAT TREATMENT OF STEEL TRACTOR CASTINGS, by Fred Grotts, Holt Mfg. Co., Peoria, Ill.

ELECTRIC STEEL MAKING, by James W. Galvin, Ohio Steel Foundry Co., Springfield, O.

Wednesday, Oct. 6

2:00 P. M.—Industrial Relations.

INDUSTRIAL RELATIONSHIPS BETWEEN EMPLOYER AND EMPLOYE, by Myer Bloomfield, Industrial Relations, Boston, Mass.

TRAINING FOUNDRY EXECUTIVES, by R. E. Kennedy and Bruce W. Benedict, Shop Laboratories, University of Illinois, Urbana, Ill.

THE FOREMAN'S RELATIONSHIP TO THE WORKER, by Charles Prosser, director, Dunwoodye institute, Minneapolis.

DEVELOPING THE FOREMAN, by M. C. Evans, secretary, Foreman's Development Course Committee, International Harvester Co., Chicago.

AMERICANIZATION, by Fred H. Rindge, executive secretary, Y. M. C. A., New York.

REPORT OF COMMITTEE ON SAFETY, SANITATION AND FIRE PREVENTION, by Benjamin D. Fuller, chairman, Niagara Falls, N. Y.

Thursday, Oct. 7

9:30 A. M.—Industrial Relations.

THE RIGHT MAN ON THE RIGHT JOB, by Arthur H. Young, manager, industrial relations, International Harvester Co., Chicago.

MODERN EMPLOYMENT AND PERSONNEL METHODS, by Dudley R. Kennedy, Cluett, Peabody & Co., Troy, N. Y.

EMPLOYMENT PROBLEMS, by Ralph M. Wells, Employment Managers' association, 6 Beacon street, Boston.

INDUSTRIAL RELATIONS WORK AS APPLIED TO FOUNDRIES, by James W. Brown, manager industrial relations department, Chain Belt Co., Milwaukee.

VARIOUS PLANS OF INDUSTRIAL RELATIONS, by Ray Vance, service director, Brookmire Economic Service, Inc., New York.

EDUCATION AND VOCATIONAL TRAINING FOR EMPLOYES, by A. C. Horrocks, educational director, Goodyear Tire & Rubber Co., Akron, O.

REPORT OF COMMITTEE ON INDUSTRIAL EDUCATION AND TRAINING OF APPRENTICES, by C. B. Connelley, chairman, department of labor and industry, Harrisburg, Pa.

Thursday, Oct. 7

9:30 A. M.—General and Metallographic Session of the Institute of Metals Division of A. I. M. M. E.

CHARPY IMPACT TEST AS APPLIED TO ALUMINUM ALLOYS, by E. H. Dix.

COLLOIDAL STATE IN METALS AND ALLOYS, by Jerome Alexander.

TRANSITION PHENOMENA IN AMALGAMS, by A. W. Gray.

PHYSICAL TESTS ON SHEET NICKEL-SILVER, by W. B. Price and P. Davidson.

NICKEL-CHROMIUM ALLOYS, by Leon O. Hart.

COPPER CRUSHER CYLINDERS, by A. J. Kiyintzky.

Thursday, Oct. 7

8:00 P. M.—Business Meeting.

ANNUAL ADDRESS OF THE PRESIDENT, by C. S. Koch, Fort Pitt Steel Foundry Co., McKeesport, Pa.

REPORT OF BOARD OF DIRECTORS, by C. E. Hoyt, secretary.

REPORT OF SECRETARY-TREASURER, by C. E. Hoyt, secretary.

AMERICANIZATION, by Dr. R. M. Little, director, American Institute of Safety, New York.

9:00 P. M.—Smoker.

Friday, Oct. 8

9:30 A. M.—Technical Session—Malleable Iron.

THE TRIPLEX PROCESS OF MAKING MALLEABLE IRON, by H. A. Schwartz, National Malleable Castings Co., Indianapolis.

NOTES ON MALLEABLE IRON, by Enrique Touceda, Albany, N. Y.

FRACTURES AND MICROSTRUCTURES OF AMERICAN MALLEABLE CAST IRON, by W. R. Bean, H. W. Highriter and E. S. Davenport, Eastern Malleable Iron Co., Naugatuck, Conn.

A NEW RESEARCH DEPARTMENT FOR A LARGE MALLEABLE PLANT, by H. A. Schwartz, National Malleable Castings Co., Indianapolis.

FUEL AND COMBUSTION, by Max Sklovsky, Deere & Co., Moline, Ill.

REFRACTORY BRICK AND MATERIALS, by Dr. M. L. Hartman, Carborundum Co., Niagara Falls, N. Y.

REPORT OF COMMITTEE ON SPECIFICATIONS FOR MALLEABLE IRON CASTINGS, by Enrique Touceda, chairman, Albany, N. Y.

Friday, Oct. 8

9:30 A. M.—General Session.

THE CARE OF FOUNDRY EQUIPMENT, by David McLain, McLain's System, Milwaukee.

IMPORTANT CONSIDERATIONS IN THE DESIGN OF MODERN FOUNDRIES, by J. H. Hopp, Charles C. Kawin Co., Chicago.

CLEANING ROOM METHODS, by A. W. Gregg, Whiting Foundry Equipment Co., Chicago.

ARC WELDING MACHINES FOR THE FOUNDRY, by A. M. Candy, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

THE FUSION WELDING OF IRON CASTINGS, by A. S. Kinsey, Stevens Institute of Technology, Hoboken, N. J.

PROPER ILLUMINATION AS AN AID TO FOUNDRY PRODUCTION, by James Brakes Jr., Chicago.

THE EQUIPMENT OF THE FOUNDRY—TODAY AND IN THE NEAR FUTURE, by A. R. Atwater, Osborn Mfg. Co., Cleveland.

APPROVED METHODS OF TESTING MOLDING SAND, by S. W. Stratton, Bureau of Standards, Washington.

REPORT OF COMMITTEE ADVISORY TO THE U. S. BUREAU OF STANDARDS, by Richard Moldenke, Watchung, N. J.

COST ACCOUNTING, by F. C. Everett, Miller, Franklin, Bassett & Co., New York.

REPORT OF COMMITTEE ON FOUNDRY COSTS, by J. Roy Tanner, Pittsburgh Valve, Foundry & Construction Co., Pittsburgh.

BRITISH AND CONTINENTAL MOLDING MACHINES, by H. Cole Estep, Penton Publishing Co., London, Eng.

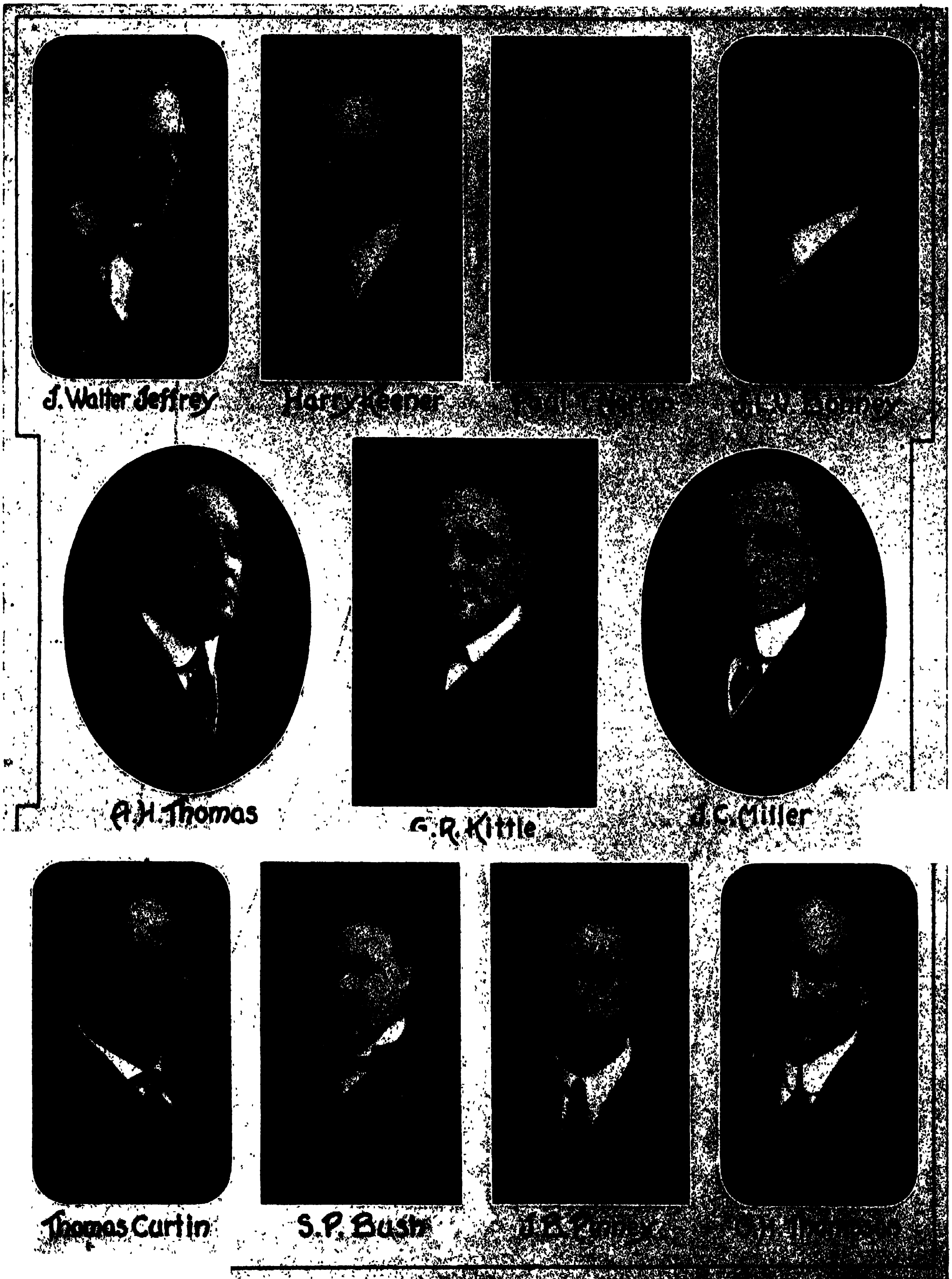
FOUNDRY ENGINEERING, by Frank D. Chase, Frank D. Chase, Inc., Chicago.

THE ONE BEST WAY TO DO WORK, by F. B. Gilbreth, Montclair, N. J.

THE FOUNDRY OF THE U. S. S. PROMETHEUS, REPAIR SHIP OF THE ATLANTIC FLEET, by Lieut. R. F. Nourse, United States navy.

REPORT OF COMMITTEE ON SPECIFICATIONS FOR FOUNDRY SCRAP, by J. G. Garrard, chairman, Northwestern Malleable Iron Co., Milwaukee.

CONCRETE MOLDING FLOORS, by Lieut.-Col. H. C. Boyden, Portland Cement Association, Chicago.



COLUMBUS BUSINESS MEN AND MANUFACTURERS HAVE TAKEN AN ACTIVE PART IN PREPARING FOR THE CONVENTION AND THE RECEPTION OF THE VISITING FOUNDRYMEN—A PROGRAM OF ENTERTAINMENT FOR THE LADIES AND A SERIES OF VISITS TO LOCAL PLANTS HAS BEEN ARRANGED

States navy will describe an unusual foundry which is in operation on a repair ship of the Atlantic fleet.

A program of entertainment to include an entire afternoon for diversion on Thursday to be followed by a smoker in the evening is being provided by a Columbus committee working together with a committee appointed by President Koch of the association.

That the annual convention of the American Foundrymen's association offers the best possible opportunity to present to prospective buyers the merit of their products, is evidenced by the growing interest from year to year in the exhibition on the part of both material and equipment firms which supply foundry needs. This year the seven buildings at the fair grounds offer the best possible conditions for display and demonstration purposes. This natural division of the show permits exhibits to be grouped according to their similar nature, and gives the visitor an opportunity to spend a greater amount of time with those in which he is most vitally interested. At the same time, the arrangement is such that it is possible to proceed from one building to the next almost without being conscious that the displays are housed in separate structures. A greater number of firms have contracted for space this year than at any time in the past, and the rapid strides evident in many lines since the war may be noted at this time.

Unlike many of the cities which have entertained annual sessions of the American Foundrymen's association in the past, Columbus is not preeminently a foundry center. Judged on the basis of the number of shops or the tonnage of products, this city is not to be compared with some of those whose natural advantages have entitled them to be ranked as leaders in the industry which supports and derives marked advantages from the Foundrymen's association. However, viewing the shops as units, and comparing them upon a similar basis with those in other cities, the foundries of Columbus will be found to be progressive, well managed and exceptionally efficient.

Columbus dates back to 1797 when a Kentucky surveyor laid off the village of Franklinton, now west Columbus. The capital city, as such did not come into being until 1812, when the legislature in session at Zanesville, settled upon this site on the banks of the Scioto river as the logical geographical location for the state government. Flour mills, following the logical course of human necessity gave the first indication of active industrial life, and then as settlers commenced to find their way into this fertile region, the need for implements of iron to reduce the wilderness and to develop the great agricultural promise of the country brought about the establishment of the first foundry and plow works. This was a plant built by Joseph Ridgeway and put into operation in 1822. Ridgeway's foundry probably marks one of the earliest steps in the establishment of the great foundry industry of Ohio, which extends throughout the state and finds its greatest development in the vicinity of Cleveland and of Cincinnati.

Another pioneer foundryman of Columbus was John L. Gill who in 1826 built one of the first car and car wheel plants in the country. Mr. Gill was prominently identified with the early development of the city. He brought the first coal from some of the newly opened regions in southern Ohio. When a branch was constructed, connecting the capital with the canal which extended the length of the state, the first boats over the lateral canal from Circleville carried consignments to the Gill foundries. John L. Gill was the first to make coke in that section of the state, and the first to engage in a commission business in iron. This was at a time when Columbus was a city of only about 2000 to 3000 population. The Gill plant, like the Ridgeway foundry was sold, and both since have become extinct.

Among the three oldest firms in Columbus which still are engaged in business are the Kilbourne-Jacobs Co., the Kinnear Mfg. Co. and the Jeffrey Mfg. Co. The former was established by Col. James Kilbourne soon after the Civil war and the second was started as W. R. Kinnear & Co., manufacturers of iron cornices, in 1878.

The third establishment, and the one which is perhaps the largest industrial plant in Columbus at the present time is the Jeffrey Mfg. Co.

The Jeffrey Mfg. Co., established in 1876, had its beginning in a small one-room workshop, where Joseph A. Jeffrey, who is now and has been the head of this organization since it was founded, started to build a novel apparatus for cutting coal. Two years later saw a company incorporated with Mr. Jeffrey at its head. The business grew steadily and in 1888 it established itself in its present location.

It was natural that the company should not long confine itself to one piece of mining machinery, and it soon became an engineering center for mechanical problems relative to coal mining and the handling of all kinds of materials. The Jeffrey plant today covers over 30 acres of floor space, and is said to be the largest concern of its kind in the world. Over 3000 people are employed.

In the manufacture of the company's products no efforts and expense are spared to secure the highest standard of excellence. The highest grade of skilled mechanics are employed and the plant is thoroughly equipped with the most modern labor-saving devices for economical production and distribution. In addition to the manufacture of coal cutters, drills, pit car loaders, mine locomotives, tipple machinery equipment, including car hauls, screens, picking tables, loading booms and ventilating fans, the output of the Jeffrey Mfg. Co. now includes elevating and conveying equipment for the handling of materials in practically every industry. Chains of all

Columbus Local Committees

General Chairman

G. R. KITTLE,
The Ohio Malleable Iron Co.

Finance Committee

A. H. THOMAS, Chairman,
The Buckeye Steel Castings Co.
J. C. MILLER, Vice Chairman,
The American Rolling Mill Co.

Information Committee

THOMAS CURTIN, Chairman,
The Ralston Steel Car Co.
HARRY KEENER, Vice Chairman,
The Keener Sand & Clay Co.

Entertainment Committee

J. L. V. BONNEY, Chairman,
The Bonney-Floyd Co.
S. P. BUSH, Vice Chairman,
The Buckeye Steel Castings Co.
J. WALTER JEFFREY,
The Jeffrey Mfg. Co.
SAMUEL SUMMER,
The Jos. Schonthal Iron Co.
J. S. BALL,
The Central Foundry Equipment Co.

Plant Visitation Committee

G. H. THOMPSON, Chairman,
The Columbus Malleable Iron Co.
J. B. PINNEY, Vice Chairman,
The Jos. Schonthal Iron Co.
WALTER F. SHELDON,
The Jos. Schonthal Iron Co.

Automobile Committee

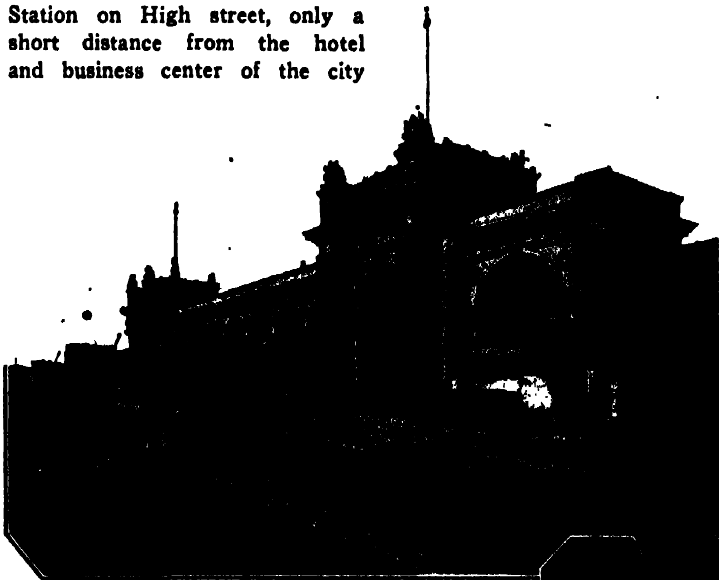
HARRY KEENER, Chairman,
The Keener Sand & Clay Co.
NELSON ROSE, Vice Chairman,
The Jones Sand Co.

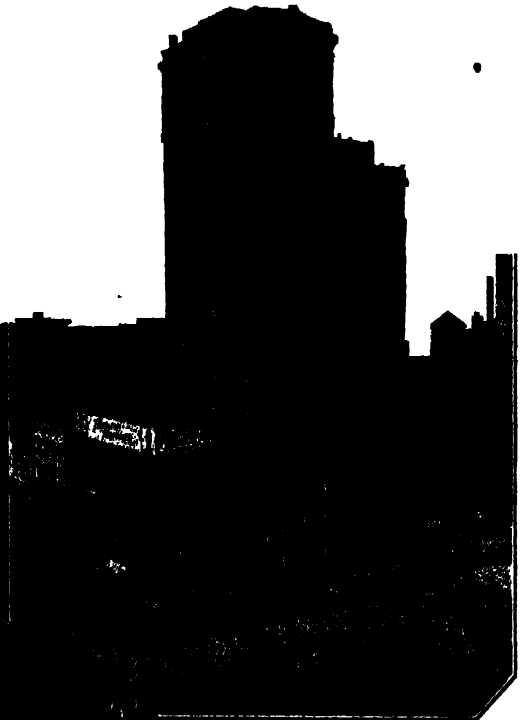
Golf Committee

PAUL T. NORTON, Chairman,
The Case Crane & Engineering Co.
J. WALTER JEFFREY, Vice Chairman,
The Jeffrey Mfg. Co
WALTER B. FLOYD,
The Bonney-Floyd Co.

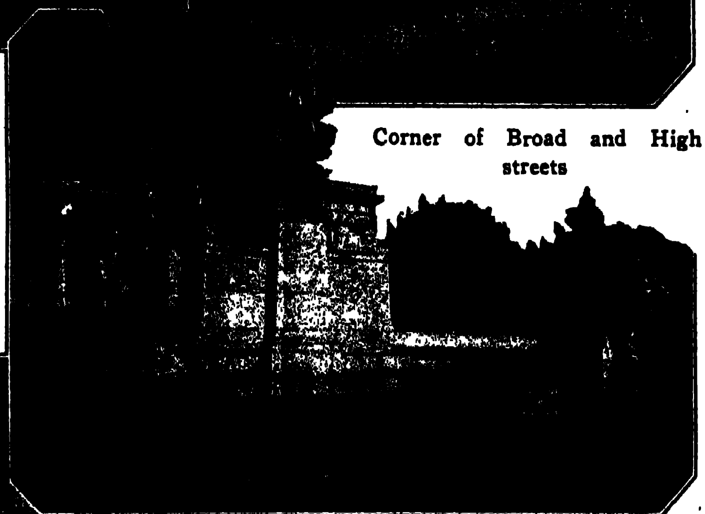
Features of Civic Beauty and Industrial

The visitor arrives at the Union Station on High street, only a short distance from the hotel and business center of the city



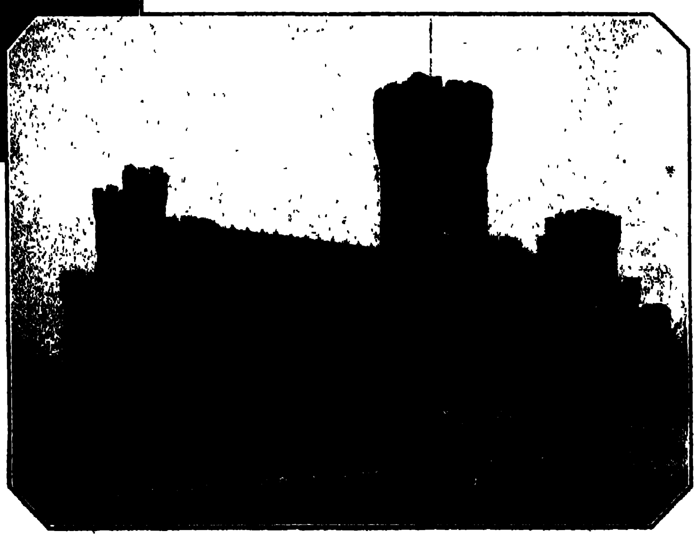


Corner of Broad and High streets



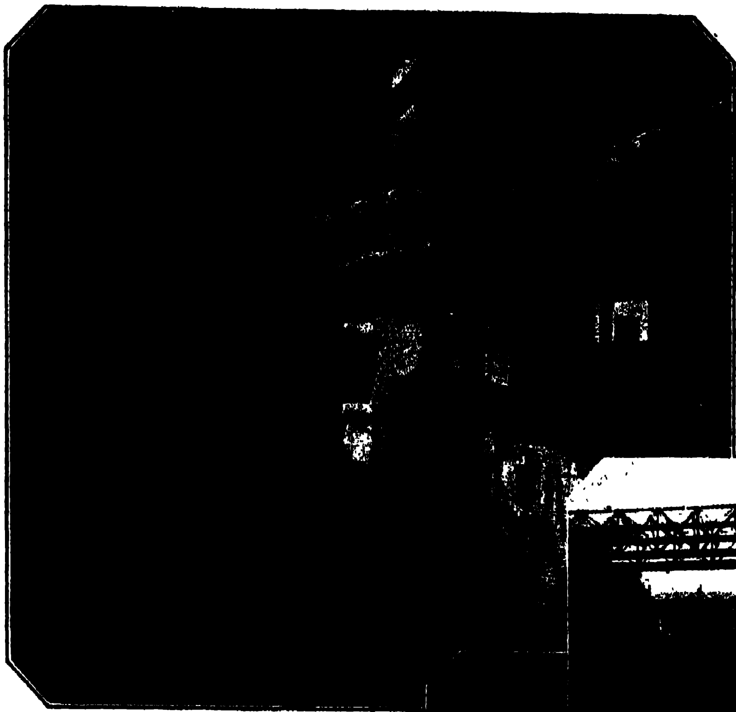
A beautiful memorial to William McKinley stands at the main entrance to the State House. Bronze figures at the right and left typify the arts and industries of the state

An exceptionally beautiful public library has been provided for the citizens of Columbus. This is maintained by the city



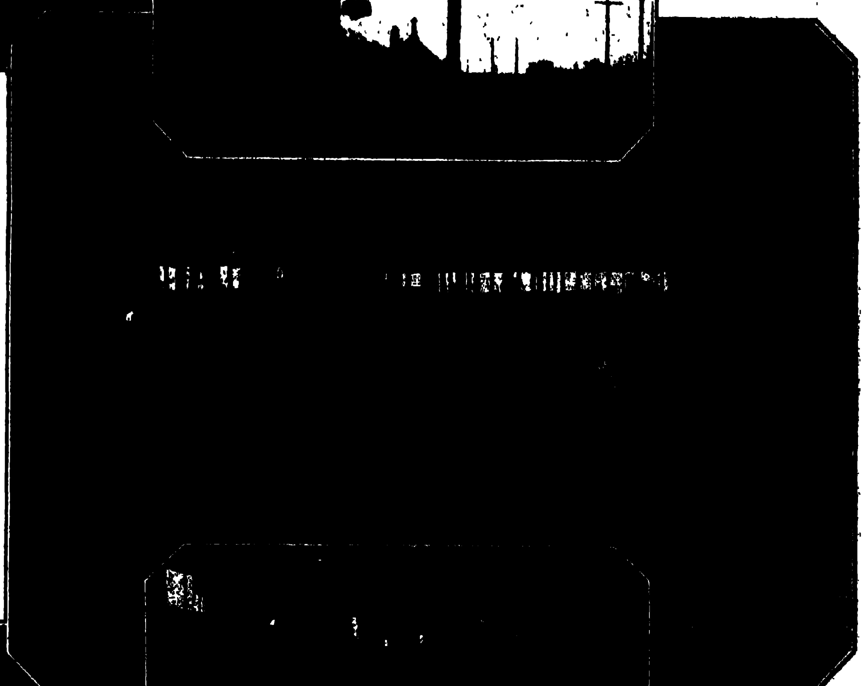
Ohio State University with over 7000 students is situated at the north end of High street. The building at the left is the gymnasium and armory. The cadet regiment numbers over 1800 men who are drilled under army officers

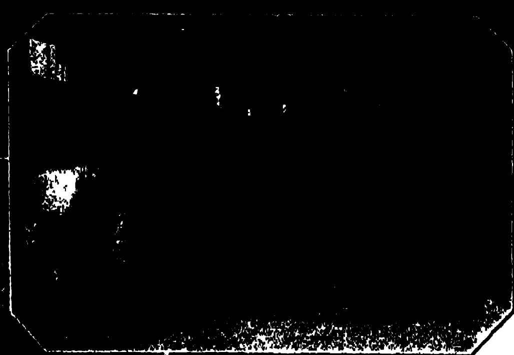
Activity Will Attract Convention Visitors

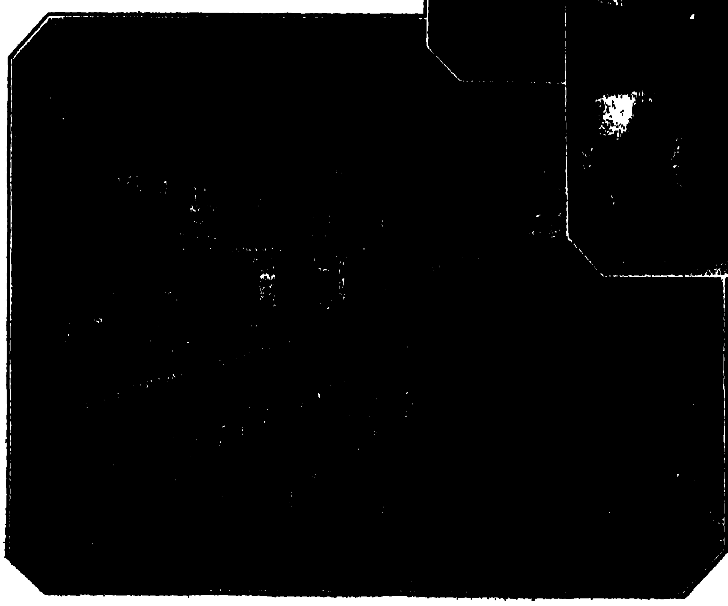


Some foundries of unusual interest will be opened to visitors during the convention. The malleable shop of which an interior and yard view are shown is one of the best equipped in the state. Extensive welfare work is carried on by this company

A number of exceptional foundries in Columbus form departments of large industrial establishments. The one at the right supplies gray-iron castings for a mining machinery manufacturer







The two steel foundries of Columbus are exceptional. At the left is an exclusive railway castings shop, while above are shown some examples of large steel castings from a foundry making jobbing castings

types for elevating, conveying and power transmission purposes, portable truck and wagon loaders, crushers, pulverizers, shredders, portable limepulvers, and numerous other products for conserving human energy, lowering operating costs and increasing efficiency and production are manufactured.

The Jeffrey force of employes has its own building and loan association, mutual aid society, also co-operative employes restaurant, bakery and store, where meals and goods, may be obtained at cost. The Jeffrey company operates a gray-iron foundry.

A subsidiary of the Jeffrey company, and an establishment which will hold much of interest to the foundrymen attending the convention, is the Ohio Malleable Iron Co. This company is headed by J. A. Jeffrey, president. The other officers are J. Walter Jeffrey, vice president; C. W. Miller, secretary and treasurer; G. R. Kittle, general manager, and J. M. Kittle, assistant. The Ohio Malleable plant is one of the best equipped malleable shops in the state from the standpoint of labor saving appliances. From the clam-shell and magnet equipped cranes in the material yards to the loading cranes in the shipping department, every conceivable advantage is taken in substituting mechanical for human effort. Overhead charging cranes serve each air furnace, of which six are operated simultaneously. Steam and electric charging machines handle the annealing pots into and out of the ovens. Sand cutters, and monorails aid in preparing and handling the sand for daily use. As stated, the company operates six air furnaces every day. Each of these has a maximum capacity of 40 tons, and a monthly output of over 2000 tons is attained. When operating at full schedule, this shop employs about 1000 men, including 250 skilled molders. The company makes castings which average about 1 pound in weight. Over 40 per cent of the production goes to the Jeffrey Mfg. Co., while the remainder is taken by automobile and car manufacturers.

As in the case of the Jeffrey plant, co-operative stores are maintained where employes may buy groceries and general sundries at cost. A company restaurant across the street from the plant provides lunches for the men. During the recent housing shortage, the company purchased 26 acres of land and assisted its employes in financing homes.

Another leading malleable foundry of the city is the Columbus Malleable Iron Co. which was established in 1911, through a reorganization of the Columbus Malleable Castings Co. This foundry operates three 20-ton, coal-fired air furnaces and anneals in nine ovens utilizing the same fuel. Its average output is 400 tons per month, and consists of agricultural implement, automobile, car and medium weight jobbing castings. G. H. Thompson, who is well known throughout the malleable industry, is president, J. D. Price is vice president and G. A. Johnson is secretary and treasurer, of the company.

Excells in Steel Casting

Columbus has only two steel foundries. These are the Bonney-Floyd Co. and the Buckeye Steel Castings Co. The Bonney-Floyd company is a particularly progressive institution. It has an average production of 12,000 tons per year, but under stress of war demands it has produced as high as 1400 tons of high grade steel castings in a single month. Castings are made ranging in weight from 1 pound to 10 or 11 tons. A 15-ton basic open-hearth furnace and three 3-ton converters supply the metal at the present time, and a new 3-ton Ludlum electric furnace is being installed. This unit probably will be in operation and open to inspection at the time of the convention. Every casting made in the plant is annealed. Five annealing furnaces, which are rigged to utilize either natural gas or oil fuel, are in service, and full pyrometric control is exercised.

The company manufactures general miscellaneous steel castings and its versatility is shown by a list of its products which includes castings for cranes, tractors, railway cars and locomotives, coal mining machinery, hydraulic presses, motors, pumps, crushing machinery, ship operating machinery, turbines, steam shovel and excavating equipment. During the war, in addition to supplying the demands of its regular customers, this company produced all steel castings entering into the construction of the so-called *Pershing* locomotives, castings for powder works, ship castings which met the Lloyds and American bureau specifications, and special steel billets for forging into shells. Over two-thirds of the output of the plant at present is taken by firms located outside of Columbus.

The Bonney-Floyd Co. was organized in 1906 by J. L. V. Bonney and W. B. Floyd. The plant started operations in 1907, coincident with the panic of that year, with a maximum capacity of 200 tons per month. That it has successfully survived and prospered is shown by its present large output and the fact that it has grown and expanded until its property now embraces about 17 acres of ground.

The Buckeye Steel Castings Co. originated with the old Buckeye Malleable & Coupler Co. Its first president was Maj. W. J. Goodspeed, who secured the services of S. P. Bush, the present president, as superintendent. When a federal law was passed requiring all couplers to be made of cast steel, a new plant was secured and the present business was established. This was about 1902. The company was one of the first to manufacture a patented steel coupler and this continued to be the principal product of the plant until 1906 or 1907 when the production of cast steel side frames and bolsters for railway freight cars was undertaken. The shop now is strictly a specialty foundry making these castings for railway service. About 2000 men are employed.

The introduction of Mr. Bush into the foundry business was rather unusual. He came to the Buckeye plant from the Chicago, Milwaukee & St. Paul railway, where he was superintendent of motive power at Milwaukee. Previously he had been with the Pennsylvania railway and had served his apprenticeship in the shops of that company in Columbus. Mr. Bush at present is president and general manager of the company; R. S. Warner, is first vice president; J. C. Whitridge, second vice president; and Arno Eberlein, secretary and treasurer. A. H. Thomas is superintendent of the foundry.

Columbus is a large center for gray-iron jobbing castings. One of the oldest firms engaged in this line of business is that of Henry Loudenslager which was established about 45 years ago. Henry Loudenslager, who died some years ago, originally was with the Gill car wheel foundry mentioned earlier in this article. At the age of 21, he became foreman for the Columbus Machine Co., and left this position to enter the foundry business for himself. At present his two sons operate the shop, which produces from 15 to 18 tons per day of castings weighing up to 6 tons, including general jobbing and municipal castings. Henry Loudenslager, Jr., is manager and he is assisted by his brother, Walter J. Loudenslager.

The Ebinger Sanitary Mfg. Co., employing about 100 men, makes bath tubs and fixtures, fountains and general plumbing castings in gray iron. The two stove shops of the city are C. Emrich and A. T. Nye & Son Co. The former employs about 100 men and manufactures stoves complete. The U. S. Cast Iron Pipe & Foundry

(Concluded on page 732)

Who and What to See at the Big Show

Total Floor Space Occupied, Variety of Product and Equipment Shown and Number of Manufacturers Participating Will Exceed All Previous Events of This Character

ABRASIVE INDUSTRY, Cleveland.—This booth will be fitted up as a rest room and visitors may consider this booth their headquarters while in attendance at the conve[illegible] and exhibition. A large assortment of techni[illegible] books will be on display. Represented by John A. Penton, A. O. Backert, J. D. Pease, C. J. Stark, F. V. Cole, D. M. Avey, H. E. Diller, Pat Dwyer, Charles Vickers, E. L. Shaner, A. L. Klingeman, L. C. Pelott, S. H. Jasper, J. F. Ahrens and G. B. Howarth.

ACHESON GRAPHITE CO., Niagara Falls, N. Y. —This exhibit will consist of electric furnace electrodes; welding electrodes; graphite molds in which castings can be poured and foundry facings represented by Acheson Smith, H. P. Martin, L. C. Judson and Atwood B. Ostman.

AIR REDUCTION SALES CO., New York.—Demonstrations will be made of welding and cutting torches and a complete display of apparatus; oxygen and acetylene cylinders will be maintained; represented by A. S. Kinsey, A. R. Ludlow, L. A. Sholes, G. H. Crofton, H. H. Melville and A. D. Frost.

AJAX METAL CO., Philadelphia.—In addition to the customary line of ingots and castings will also exhibit a 60 kilowatt electric furnace; represented by G. H. Clamer, W. J. Coane, Frank M. Willson, Louis E. Purnell, John G. Miller, James K. Wyatt, Donald H. Fairfield.

AKRON CULTIVATOR & MANUFACTURING CO., Akron, O.—Will show one and two wheel tubular barrows; patent charging barrows; contractors barrows and concrete carts; represented by H. W. Melvin, R. R. Roemer, C. E. Holcomb, and G. M. Winwood Jr.

AMERICAN BORON PRODUCTS CO., Reading, Pa. —This exhibit will consist of sample cases of alloys together with castings treated with these alloys; represented by J. Fred Smith, John Ramer and C. F. Molley.

AMERICAN FOUNDRY EQUIPMENT CO., New York.—This company plans to show sand cutting machine, sandblast room, sandblast barrel, cloth screen dust arrester, annealing oven charging truck, core machine, molding machine, corrugated steel flasks, aluminum snap flasks and pattern mounting compound; represented by Verne E. Minich, Elmer A. Rich, Hutton H. Haley, James Rigby Jr., Robert H. Kelly, Charles G. Smith, Jerome E. Sweet, C. B. Schneible, E. J. Turnbull, C. D. Steinmeier, David Logan, R. S. Buch.

AMERICAN HOMINY CO., Indianapolis.—Will exhibit and demonstrate a core binder which is manufactured as a by-product; represented by George B. Hill, William R. Martin, Robert C. Herms and John A. Green.

AMERICAN LA FRANCE FI[illegible] ENGINE CO., Pittsburgh.—Is arranging to exhibit a complete safety first line, showing such articles as safety signs, respirators, respirator masks and hoods, pure air supply apparatus, emergency breathing devices, gas filter masks, protective goggles, first aid supplies, mechanics' gloves, bulletin boards and blackboards, rubber gloves, asbestos clothing, gloves and leggings, safety nonexplosive cans, and safety portable lines. The company also is arranging to exhibit articles used for fire fighting equipment, such as sodas and acid extinguishers, carbon tetrachloride extinguishers, nozzles, hose, etc.; represented by R. C. Engels, T. A. Miller and H. J. Lovell.

AMERICAN MOLDING MACHINE CO., Terre Haute, Ind.—Different types of molding machines including jolt rockover, jolt stripper, air and hand squeezers will be displayed; represented by W. C. Norcross, F. N. Perkins, and Thomas Marsh.

AMERICAN WOODWORKING MACHINERY CO., Rochester, N. Y.—Woodworking machinery for the pattern shop will be shown at the booth of this company; represented by Geo. Ely, R. T. Maston, and A. H. Jones.

ARCADE MFG. CO., Freeport, Ill.—The exhibit of this company will comprise eight different types of molding machines and also an installation showing the application of a patented pouring device; represented by E. H. Morgan, Charles Morgan, L. L. Munn, Henry Tschering, August Christen, G. D. Wolfley, R. E. Turnbull, and Mentor Wheat.

ASBURY GRAPHITE WORKS, Asbury, N. J.—Are planning to have several sand molds in their booth to demonstrate to practical foundrymen the difference in foundry facings. This feature has never been shown before and will be of particular interest to a great number of visitors, a collection of graphite ore also will be shown; represented by H. M. Riddle Jr. and others.

ASHLAND BRASS FOUNDRY, Ashland, O.—Expect to have a display of aluminum match plate pattern equipment; represented by Waldo Kauffman.

ATKINS, E. C., & CO., Indianapolis.—The exhibit of this company will include a metal band sawing machine, a new and improved type of hack saw machine, together with various other styles and types of standard saws and blades for all purposes; represented by T. A. Carroll, T. H. Endicott, Edward Norvel, B. D. Thompson, A. Mertz and Samuel P. Moore.

AUSTIN CO., Cleveland.—Will exhibit models, drawings, photographs, and literature on standard buildings, more especially of the foundry type. Information regarding foundry and steel plant service will be available. The models of buildings will be larger than those shown at previous conventions, and will be of sufficient size so that many of the minor details can easily be shown, thus affording minute inspection into methods and various types of construction; represented by O. D. Conover, G. A. Bryant, A. L. Chubb, C. F. Chard, and R. A. Curtis.

AUTOMATIC TRANSPORTATION CO., Buffalo.—Several types of automatic industrial tracks and tractors will be shown by this company. They will also exhibit some sub-assembly units, together with direct current charging equipment; represented by Russel J. Mulholland, George F. Simons, Clarence E. Ogden, Thomas F. Donahue, and O. H. Goodsell.

BACHARACH INDUSTRIAL INSTRUMENT CO., Pittsburgh, Pa.—A complete demonstration outfit for measuring the air blast in foundry cupolas will be shown; also recording meters used by some of the larger foundries for taking continuous chart records of the air blast; represented by L. J. Seedel.

BAKER BROS., Toledo, O.—Intend to exhibit a heavy duty boring and drilling machine and a newly designed 2-spindle drill; represented by Wallace Elliott, Herbert Tigges, George Hallen[illegible]ck and W. Baker.

BARRETT-CRAVENS CO., Chicago.

BARTLETT & SNOW, C. O., CO., Cleveland.

BASTIAN BLESSING CO., Chicago.

BAUER, A. E., & SON, Chicago.—A revolving knife wood trimmer will be shown at the booth of this company; represented by William E. Bauer and Walter E. Bauer.

BAUSCH & LOMB OPTICAL CO., Rochester, N. Y. —It is the intention of this company to exhibit a complete line of metallographic apparatus, that is, an apparatus for photographing polished and etched surfaces of iron, steel, brass, etc. A complete line of apparatus for this purpose will be exhibited in operation.

BEAUDRY & CO., Boston.—A ¼-size motor driven working model of a power hammer will be employed to demonstrate the scope and capacity of this form of equipment; represented by A. Parsons.

BERKSHIRE MFG. CO., Cleveland.—Besides automatic molding machines, air squeezer machines, combination jolt and squeeze machines, demonstrations will be given of vibrators, electric sand riddles, flasks, etc.; represented by W. D. Fraser, G. L. Cannon, J. A. Scott, J. R. Burke.

BESLY, CHAS. H., CO., Chicago.

BETHLEHEM STEEL CO., Bethlehem, Pa.—Expect to feature pig iron for special foundry purposes as produced at the Sparrow's Point plant; represented by Robert MacDonald and several other representatives who also will be there in connection with various general products produced by the company.

BEYER MACHINE CO., Jackson, Mich.—Will exhibit a rotary sand riddle of new design; represented by F. W. Beyer.

BIRKENSTEIN, S., & SONS, Chicago.—At this booth a full line of nonferrous metals will be shown including ingot brass, ingot copper, ingot bronze, pig tin, pig lead, aluminum, solder, manganese bronze, babbitt, phosphor tin, and phosphor copper. A display of castings made from these metals will also be shown; represented by Harry Birkenstein, George Birkenstein, Charles B. Raphael, Matt Schero, Herman Goldstine, Eli Brown, Louis Carlale, Sidney Pflaum, A. J. Smith.

BLACK & DECKER MFG. CO., The, Baltimore.

BLACK DIAMOND SAW & MACHINE WORKS, Natick, Mass.—Will exhibit a band saw filing and setting machine, motor driven; a circular saw filing machine, motor driven; a disc sander, motor driven; a spindle sander, motor driven; a band saw brazing outfit; ball-bearing band saw guides; represented by W. B. Ambler, Edward Gordon, and W. B. Pigeman.

BLAW-KNOX CO., Pittsburgh.—Intend to exhibit one of their standard foundry clamshell buckets, water cooled furnace appliances, and will include by means of photographs or otherwise, display of their entire line of products, excluding those which would be of no special interest to the foundry trade; represented by J. H. Flynn and D. C. Grove.

BLYSTONE MFG. CO., Cambridge Springs, Pa.—This company will show a regular sand mixer equipped with screen, motor and power discharge; represented by D. C. Smith, T. A. Graham and Luther G. Conroe.

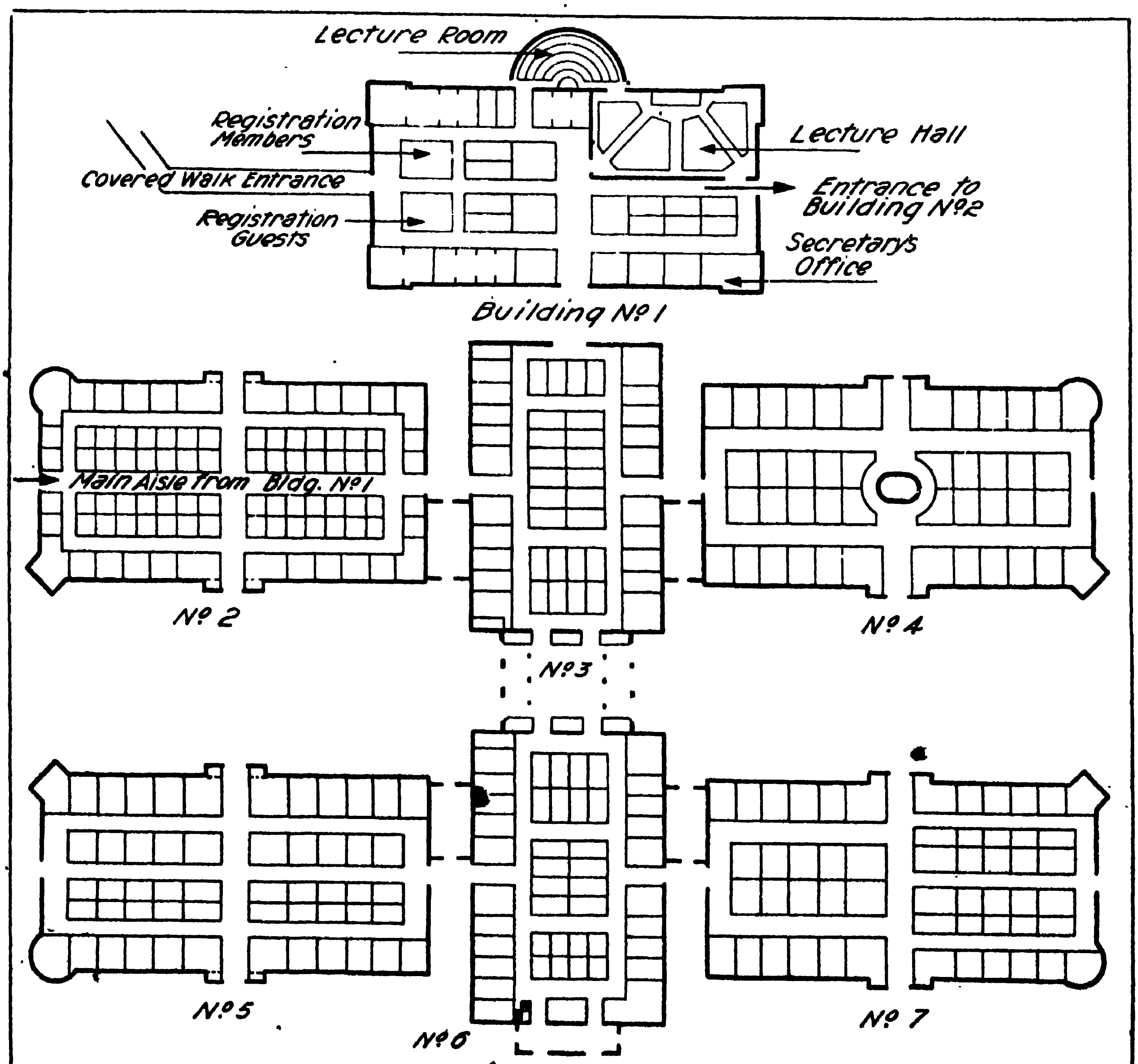
BOOTH ELECTRIC FURNACE CO., Chicago.—There will be on display a standard 1000-pound rotating electric furnace especially designed for melting nonferrous metals. This furnace will be equipped with automatic electrode control and motor will be connected so that furnace can be placed in rotation and all details explained to visitors. Photographs and other interesting data showing an electric conducting hearth furnace which is being used in melting steel, iron and other ferrous metals, will be shown and also castings and other products of the electric furnace; represented by C. H. Booth, D. E. Carpenter, M. A. Beltaire Jr., C. J. Goehringer, and Arthur Crabbe.

BRASS WORLD PUBLISHING CO., New York.

BRITISH ALUMINUM CO., LTD., London.—Will show standard ingots, both pure and in regular alloys of the various shapes supplied to the trade. Also samples of aluminum sheet, different gages and tempers and a selection from many hundred extruded moldings and sections. They will also have an interesting line of samples, showing the bauxite, cryolite and other raw materials, entering into

Where to Find Exhibitors at the Columbus Show

Building No.	Exhibitor	Address
3	*Abrasive Industry*	Cleveland
6	Acheson Graphite Co.	Niagara Falls, N. Y.
6	Air Reduction Sales Co.	New York
2	Ajax Metal Co.	Philadelphia
3	Akron Cultivator & Mfg. Co.	Akron, O.
1	American Boron Products Co.	Reading, Pa.
7	American Foundry Equipment Co.	New York
2	American Hominy Co.	Indianapolis
1	American LaFrance Fire Engine Co.	Pittsburgh
7	American Molding Machine Co.	Terre Haute, Ind.
5	American Woodworking Machinery Co.	Rochester, N. Y.
7	Arcade Manufacturing Co.	Freeport, Ill.
2	Asbury Graphite Mills	Asbury, N. J.
2	Ashland Brass Foundry	Ashland, O.
5	Atkins, E. C. & Co.	Indianapolis
1	Austin Co., The	Cleveland
2	Automatic Transportation Co.	Buffalo
2	Bacharach Industrial Instrument Co.	Pittsburgh
5	Baker Brothers	Toledo
3	Barrett-Cravens Co.	Chicago
3	Bartlett & Snow, C. O. Co.	Cleveland
6	Bastian Blessing Co.	Chicago
5	Bauer & Son, A. E.	Chicago
2	Bausch & Lomb Optical Co.	Rochester, N. Y.
2	Beaudry & Co.	Boston
7	Berkshire Manufacturing Co.	Cleveland
5	Besly, Chas. H., Co.	Chicago
1	Bethlehem Steel Co.	Bethlehem, Pa.
7	Beyer Machine Co.	Jackson, Mich.
1	Bukenstein, S., & Sons, Inc.	Chicago
5	Black & Decker Mfg. Co., The	Baltimore
5	Black Diamond Saw & Machine Co.	Natick, Mass.
3	Blaw-Knox Co.	Pittsburgh
7	Blystone Mfg. Co.	Cambridge Springs, Pa.
6	Booth Electric Furnace Co.	Chicago
1	Brass World Publishing Co.	New York
2	British Aluminum Co., Ltd., The	New York
2	Brown Instrument Co.	Philadelphia
3	Buckeye Products Co.	Cincinnati
6	Campbell-Hausfeld Co.	Harrison, O.
6	Carborundum Co., The	Niagara Falls, N. Y.
6	Caward-Gaskill Furnace Corp.	Chicago
7	Champion Foundry & Machine Co.	Chicago
2	Chase, Inc., Frank D.	Chicago
5	Chesapeake Iron Works	Baltimore
1	Chicago Crucible Co.	Chicago
4	Chicago Pneumatic Tool Co.	New York
1	Clark Meter Co., Chas. J.	Gladbrook, Iowa



GENERAL ARRANGEMENT OF BUILDINGS AT THE OHIO STATE FAIR GROUNDS

Where to Find Exhibitors at the Columbus Show

Building No.	Exhibitor	Address
2	Clark Tructractor Co	Buchanan, Mich.
2	Cleveland Flux Co	Cleveland
4	Cleveland Pneumatic Tool Co	Cleveland
5	Clipper Belt Lacer Co	Grand Rapids, Mich
2	Coale Lumber Co, Thomas E	Philadelphia
2	Combined Supply & Equipment Co	Buffalo
2	Cooper Manufacturing Co	York, Pa.
2	Corn Products Refining Co	New York
4	Curtis Pneumatic Machinery Co	St. Louis
3	*Daily Iron Trade and Metal Market Report*	Cleveland
7	Davenport Machine & Foundry Co	Davenport, Iowa
6	Davis Bournonville Co	Jersey City, N. J.
4	Dayton Pneumatic Tool Co	Dayton, O.
6	Detroit Electric Furnace Co	Detroit
1	Detroit Soluble Oil Co	Detroit
2	Diamond Clamp & Flask Co	Richmond, Ind.
1	Diamond Oil Co	Philadelphia
5	Dings Magnetic Separator Co	Milwaukee
5	Henry Disston & Sons, Inc	Philadelphia
5	Divine Bros. Co	Utica, N. Y.
2	Dixon Crucible Co., Joseph	Chicago
2	Stanley Doggett, Inc	New York
6	Electric Furnace Co., The	Salem, O
6	Electric Welding Machine Co	Detroit
7	Federal Foundry Supply Co	Cleveland
7	Federal Malleable Co	West Allis, Wis.
1	Ferguson Co., H. K	Cleveland
2	Firefoam Service & Supply Co	Cleveland
2	Foreign Crucibles Corp., Ltd	New York
3	FOUNDRY, THE	Cleveland
2	Foundry Equipment Co, The	Cleveland
5	Gardner Machine Co	Beloit, Wis
6	Geist Manufacturing Co	Atlantic City, N. J
3	General Electric Co	Schenectady, N. Y.
2	Gordon, Inc., Robert	Chicago
7	Great Western Mfg. Co	Leavenworth, Kans.
1	Great Western Smelting & Refining Co	Chicago
7	Grimes Molding Machine Co	Detroit
5	Gurney Ball Bearing Co	Jamestown, N. Y
6	Hardinge Co	New York
2	Clement A. Hardy Co., The	Chicago
2	Hardy & Co., F. A	Chicago
2	Harris & Co., Benjamin	Chicago
2	Haskins Co., R. G	Chicago
6	Hauck Manufacturing Co	Brooklyn
5	Haynes Stellite Co	Kokomo, Ind.
5	Hayward Co	New York
5	Heald Machine Co	Worcester, Mass.
2	Hill-Brunner Foundry Supply Co	Cincinnati
2	Hill & Griffith Co., The	Cincinnati
4	Hoevel Manufacturing Corp	Jersey City, N. J.
1	Holland Core Oil Co	Chicago
6	Humphreys & Co., E C	Chicago
4	Independent Pneumatic Tool Co	Chicago
6	Industrial Electric Furnace Co	Chicago
7	Ingersoll-Rand Co	New York
7	International Molding Machine Co	Chicago
2	Interstate Sand Co	Zanesville, O.
3	*Iron Age, The*	New York
3	*Iron Trade Review, The*	Cleveland
1	Jennison-Wright Co.	Toledo, O.
1	Jones Sand Co	Columbus, O.
2	Jurack Pattern Works, Charles	Milwaukee
2	Kawin Co., Chas. C	Chicago
2	Keener Sand & Clay Co	Columbus, O.
4	Keller Pneumatic Tool Co	Chicago
1	Kellogg & Sons, Inc., Spencer	Buffalo
2	Kelly & Co., T. P., Inc	New York
7	Kilbourne & Jacobs Mfg. Co	Columbus, O.
6	King Refractories Co., Inc	Buffalo
5	Kinsey Co., E. A	Cincinnati
2	Knoeppel & Co., C. E., Inc	New York
3	Lakewood Engineering Co	Cleveland
1	Lane Co., Henry M	Detroit
4	Lewis-Shepard Co.	Boston
2	Lindsay Chaplet & Mfg. Co	Philadelphia
3	Link Belt Co	Chicago
7	Locke Pattern Works	Detroit
4	Louden Machinery Co	Fairfield, Iowa
5	Lucas Machine Tool Co	Cleveland
5	Ludlum Steel Co	Watervliet, N. Y.
2	Lupton's Sons Co., David	Philadelphia
3	McCormick Co., J. S	Pittsburgh
2	McLain's System	Milwaukee
5	*Machinery*	New York
1	MacLean Publishing Co	Toronto, Ont., Canada
4	Macleod Company, The	Cincinnati
5	Magnetic Mfg. Co	Milwaukee
6	Mahr Manufacturing Co	Minneapolis
7	Malleable Iron Fittings Co	Branford, Conn.
2	Marden, Orth & Hastings Co., Inc	New York
6	Maxon Furnace & Engineering Co	Muncie, Ind.
7	Menefee Foundry Co	Fort Wayne, Ind.
2	Mercury Mfg. Co	Chicago
2	*Metal Industry*	New York
5	Metal Saw & Machine Co.	Springfield, Mass.
6	Metal & Thermit Corp	New York
2	Michigan Smelting & Refining Co	Detroit
6	Milburn Co., Alexander	Baltimore
3	Monarch Engineering & Mfg. Co	Baltimore
4	Mott Sand Blast Mfg. Co	Brooklyn
7	Mumford Molding Machine Co	Chicago
3	National Engineering Co	Chicago
2	National Scale Co	Chicopee Falls, Mass.
7	Nicholls Co., Wm. H., Inc	Brooklyn, N. Y.
5	Norma Co. of America	Long Island City, N. Y.
5	Norton Co	Worcester, Mass
3	Obermayer Co., S	Chicago
4	Ohio Body & Blower Co., The	Cleveland
2	Ohio Equipment Co	Cleveland
2	Ohio Metal Co	Columbus, O.
4	Oldham & Son Co, George	Philadelphia
5	Oliver Machinery Co	Grand Rapids, Mich.
7	Osborn Mfg. Co	Cleveland
5	Osborne & Sexton Machinery Co	Columbus, O.
6	Oxweld Acetylene Co	Chicago
1	Paine & Co	Wilkes-Barre, Pa.
4	Pangborn Corporation	Hagerstown, Md.
3	Paxson Co., J. W	Philadelphia
3	Penton Publishing Co	Cleveland
1	Pickands Brown & Co	Chicago
2	Pittsburgh Crushed Steel Co	Pittsburgh
7	Porcelain Enamel & Mfg Co	Baltimore
4	Portage Silica Co	Youngstown, O.
7	Pridmore, Inc, Henry E	Chicago
6	Quigley Furnace Specialties Co	New York
5	Racine Tool & Machine Co	Racine, Wis.
5	*Railway Mechanical Engineer*	Chicago
3	Raymond Bros. Impact Pulverizer Co	Chicago
3	Richards-Wilcox Mfg. Co	Aurora, Ill.
1	Robinson & Co., Dwight P	New York
2	Rogers, Brown & Co	Cincinnati
3	Roots Co, P. H. & F. M	Connersville, Ind.
1	Safety Equipment Service Co	Cleveland
2	Safety First Shoe Co	Providence, R. I.
5	Simonds Mfg. Co	Fitchburg, Mass.
3	Sly Mfg. Co, W. W	Cleveland
2	Smith & Sons Co., R. P	Chicago
2	Smith Co., Werner G	Cleveland
6	Spencer Turbine Co	Hartford, Conn.
4	Standard Equipment Co	New Haven, Conn
7	Standard Sand & Machine Co	Cleveland
4	Sterling Wheelbarrow Co	West Allis, Milwaukee
2	Stevens, Frederic B	Detroit
	Stodder, W. F	Syracuse, N. Y.
4	Sullivan Machinery Co	Chicago
2	Superior Sand Co	Cleveland
6	Torchweld Equipment Co	Chicago
5	Thomas Elevator Co	Chicago
7	Teetor Co., R. J	Muskegon, Mich.
1	Truscon Steel Co	Detroit
2	United Compound Co	Buffalo
2	United States Graphite Co	Saginaw, Mich.
7	U. S. Molding Machine Co	Cleveland
2	United States Silica Co	Chicago
6	U S. Smelting Furnace Co	Belleville, Ill.
7	Vibrating Machinery Co	Chicago
2	Wadsworth Core Machine & Equipment Co	Akron, O.
5	Wallace & Co., J. D	Chicago
5	Warner & Swasey Co	Cleveland
6	Wayne Oil Tank & Pump Co	Fort Wayne, Ind.
5	Westinghouse Electric & Mfg. Co	East Pittsburgh, Pa.
1	Westinghouse Traction Brake Co	Pittsburgh
6	Wheeler Mfg. Co., F. H	Chicago
2	White & Bro	Philadelphia
2	Whitehead Bros. Co	Buffalo
5	Whiting Foundry Equipment Co	Harvey, Ill.
5	Whitman & Barnes Mfg. Co	Akron, O.
4	Woodison Co., E. J	Detroit
2	Wood's Sons Co, T. B	Chambersburg, Pa.
5	Wright Manufacturing Co	Lisbon, O.
3	Young Bros. Co	Detroit

the production of aluminum; represented by Ernest V. Pannell and Arthur Jellinek.

BROWN INSTRUMENT CO., Philadelphia.—Will display a complete line of temperature measuring instruments, including high resistance indicating and recording pyrometers and thermometers for core oven temperatures; high and low resistance portable pyrometer, for molten metal temperatures of brasses, bronzes, aluminum; indicating and recording pyrometers for heat treating and annealing steel castings; for malleable iron oven temperatures, for case hardening etc.; also all kinds of temperature measuring instruments, instruments for indicating and recording pressures, speeds, time and operation, etc.; represented by G. W. Keller, G. L. Clapper, O. L. Larson, D. L. Mathias, and R. L. Kent.

BUCKEYE PRODUCTS CO., Cincinnati.—The exhibit of this company will consist of nonferrous metal melting furnaces, oil, gas and electric, portable core drying ovens, ladle heating devices, compressed air and electric sand riddles of the latest design, patented snap flask guides and flask accessories; also various products consisting of parting compounds, general foundry facings, core compounds, fluxes, high temperature furnace cements, core oils, as well as miscellaneous items of improved foundry equipment and appliances; represented by Charles J. Goehringer, Edgar O Stamm, Dwight S. Marfield, C. M. Marcellus, D. A. Williston, G. W. Zimmerman, C. L. Gysin, H. Kunkemoeller, C. P. Stamm, D. E. Carpenter.

CAMPBELL-HAUSFELD CO, Harrison, O.—Will have the following list of exhibits; Noncrucible tilting melting furnaces; lever tilting crucible furnace No. 125 capacity crucible, gear tilting crucible furnace for No. 150 capacity crucible, aluminum tilting melting furnaces, using cast iron melting pot, capacity 100 lbs and 300 lbs. of aluminum, stationary crucible furnace taking up to No 90 crucible; all the furnaces are designed to operate on natural or artificial gas, fuel oil or kerosene, ladle and crucible pre-heaters for natural or artificial gas, combination knee and foot air vibrators, ingot stands, ingot molds, skimmers, etc; represented by Edwin B. Hausfeld, Joseph E. Hausfeld, John S. Armour.

CARBORUNDUM CO, Niagara Falls, N. Y. Will exhibit abrasive wheels, paper and cloth, disks, grains, rub stones, hones, etc., manufactured from both carborundum and aloxite Also various special and standard shapes carborundum refractory material, together with furnace linings of fire sand and examples of carborundum refractory cement applications; represented by C. E. Hawke, George Chorman, R. C. Bradbury, Leonard Pitt, O. C. Dobson, and A. A. Lees.

CAWARD GASKILL FURNACE CORP., Chicago.—Will exhibit one stationary type for size 60 crucible melting furnace; one tilting type for a No. 150 crucible melting furnace; one oscillating type quarter ton size, open flame melting furnace, non-crucible and non-retort; represented by O M. Caward

CHAMPION FOUNDRY & MACHINE CO, Chicago.—An electric sand riddle and core jolt rollover machine in operation will be on exhibition at the booth of this company; represented by T. J. Magnuson, H. O. Magnuson, Anton Magnuson.

CHASE, FRANK D., INC., Chicago.—Photographs, drawings and illustrations of modern foundry plants designed and built by the company will be shown at the exhibition booth; represented by Frank D. Chase, Morris W. Lee, L. M. Hansen, and F. I. Robertson.

CHESAPEAKE IRON WORKS, Baltimore.—Will make a comprehensive exhibit and display illustrating the merits and special features of its electric traveling crane as applied especially in foundry and to other heavy yet delicate work. The crane will be operated by a trained man from the company's works at Baltimore who will demonstrate the crane's efficiency especially in foundry service. The display will also include a feature illustrating the character of the great variety of steel structures and bridges that it has fabricated and which have been erected throughout the United States. Exhibits also will be presented illustrating the company's mechanical and electrical shop equipment for building steel structures, bridges, cranes, etc.; represented by F. S. Chavannes, C. H. Michel, J. W. Waters, C. S. Hill Jr., Frank L. Perry, Joseph Hoff, Charles R. Lambert, C. A. Sticht, E. F. Morgan, C. S. Kirk and J. Wade Miller.

CHICAGO CRUCIBLE CO., Chicago.—A complete assortment of graphite crucibles will be shown at the booth of this company; represented by L. C. Taylor, J. P. Foraker and J. W. Mann.

CHICAGO PNEUMATIC TOOL CO., New York.—Special educational devices have been worked out by the engineers of the company and the exhibit will comprise the most complete and comprehensive display which they have ever installed. The products displayed will include pneumatic motor driven air compressor in operation supplying air for an operating display of riveting, chipping and calking hammers, sand rammers in all sizes, air drills, grinders and casting cleaners, pneumatic geared hoists in all sizes. There also will be an interesting display of electric drills and grinders and a wide variety of pneumatic and electric tool accessories manufactured by the company. Represented by H. A. Jackson, A. E. Goodhue, W. H. Callen, A. C. Andersen, T. G. Smallwood, B. M Stewart, Ross Watson, R. F. Elsler, R. W. Rose, A. E. Conroe, and H. C. Gilligan.

CLARK METER CO., CHAS. J., Gladbrook, Iowa.

CLARK TRUCTRACTOR CO., Chicago.—Will have on exhibition four models of its truck as follows: One hand hoist end dump, one locomotive or tractor type, one automatic end dump, one tructractor chassis only. Three reels of industrial motion picture film will also be shown. These films show the machine at work in various foundries, factories and industrial plants; represented by H. K. Trask, L. J. Schneider, E. W. Clark, and representatives of the W. W. Williams Co., Columbus.

CLEVELAND FLUX CO., Cleveland.—A complete line of the fluxes made by the company, together with descriptive matter, etc., relative to their use will be shown. While there will not be any actual demonstration of the fluxes yet they hope to have a miniature cupola describing just how and when these fluxes are used They are putting up a very complete exhibit as well as a very attractive one; represented by Clifford B. Cornell.

CLEVELAND PNEUMATIC TOOL CO., Cleveland.—Will have on exhibition a complete line of pneumatic foundry tools also other tools not directly used in foundries but in kindred lines that are associated in construction work with the foundry, and foundry sand rammers for floor, bench and core ramming, foundry portable grinders for grinding castings in iron and steel foundries, foundry core breakers, for removing cores from large castings, foundry air drills in all types, foundry chipping hammers in several sizes adapted for light and heavy work in malleable iron, gray iron and steel castings. There will also be on exhibition a complete line of pressure seated air valves for air pipe lines in sizes used between air compressors and air tools and a complete line of air hose couplings in all sizes adapted for foundry service. The exhibition this year will be very much finer than any shown at previous conventions; represented by H. S. Covey, Arthur Scott, C. D. Garner, A. E. Ahern, R. C. Disque, and J. T. Graves.

CLIPPER BELT LACER CO., Grand Rapids, Mich.—Three different types of belt lacing machines, together with various sizes of special hooks for joining belt ends will be shown at this booth, represented by R. S. Moore.

COALE, THOS. E., LUMBER CO., Philadelphia.—The exhibit will consist of lumber for pattern and flask purposes, the same as displayed at previous shows. A full line of this material will be so arranged that the foundryman can readily find what suits his particular needs; represented by Thomas E. Coale and S. D. Pettit.

COMBINED SUPPLY & EQUIPMENT CO., INC., Buffalo.—Will show a complete line of standard and special chaplets and skim gates; represented by Stephen LeViness Jr. and C. L. Jackson.

COOPER MFG. CO., York, Pa.—Will have on exhibition at their booth samples of ore compound, core paste and silica clay for steel foundries; represented by C. F. Cooper, W. H. Fitzpatrick, and C. J. Dickey.

CORN PRODUCTS REFINING CO., New York.—The exhibit will consist of a display of cores of various kinds, also an electric oven which will be operated by a practical foundryman, making and baking cores for observation; represented by F. A. Oates, F. G. Faller Jr., D. T. McGrory, J. M. Remmes, and A. H. Kreischer.

CURTIS PNEUMATIC MACHINERY CO., St. Louis.—Will display a double cylinder, single acting, water cooled, sight feed, splash oiling air compressor; 100 cubic feet air per minute capacity. The compressor will be mounted on base with electric motor, short belt drive with idler and belt tightener. It will be equipped with water circulating pump for forced circulation of cooling water. It also will be equipped with automatic compressor unloader which operates and holds open the suction valves when the desired pressure is obtained, allowing the compressor to run with open cylinders until the pressure has fallen a few pounds; compressor does not operate against a vacuum when unloaded. All working parts of the compressor enclosed in a dust proof case. A double I-beam trolley on top hand operated bridge crane, equipped with air hoist, mounted in trunnions on trolley will also be exhibited, hoist to be air balanced for foundry control; also a bracketed single I-beam, jib crane, equipped with pendant air hoist, air balanced type, having foundry control. The entire exhibit will be operated at all open hours of the exhibition; represented by Joseph Macksey and members of the sales force.

THE DAILY IRON TRADE AND METAL MARKET REPORT, Cleveland.—This booth will be fitted up as a rest room and visitors may consider this booth their headquarters while in attendance at the convention and exhibition. A large assortment of technical books will be on display. Represented by John A. Penton, A. O Backert, J. D. Pease, C. J. Stark, F. V. Cole, D. M. Avey, H. E. Diller, Pat Dwyer, Charles Vickers, E. L. Shaner, A. L. Klingeman, L. C. Pelott, S. H. Jasper, J. F. Ahrens and G. B. Howarth.

DAVENPORT MACHINE & FOUNDRY CO., Davenport, Iowa.—Will exhibit two 24-inch jolt roll over draw molding machines, one 24-inch jolt stripper and one jolt squeezer; represented by A. D. Ziebarth.

DAVIS-BOURNONVILLE CO, Jersey City, N. J.—The exhibit will comprise a wide range of equipment for oxyacetylene and oxyhydrogen welding and cutting, including acetylene pressure generators, electrolyzers for the generation of oxygen and hydrogen, tube welding machines, with new developments in multiple flame tube welding tips, several exclusive machines for cutting with oxyacetylene and oxyhydrogen torches, including the portable radiograph, oxygraph, pyrograph for cutting flanged boiler heads, camograph for cutting hand holes and similar openings in boiler plate, and a complete line of welding and cutting torches, regulators and auxiliary equipment; represented by H. R. Swartley Jr., J. L. Anderson, H. H. Dyar, J. C. Glaum, M. S Plumley, W. W. Barnes, and a corps of expert operators.

DAYTON PNEUMATIC TOOL CO., Dayton, O.—Will display the very latest types of both bench and floor rammers, together with riveters and chippers. This company has made some very marked improvements in these tools recently and will have something of interest to show the trade at this convention; represented by A. B. Hilton Jr., L. B. George, G. C. Towle, A. B. Clausen, F. G. Baldwin, E. C. Thompson, and a number of district salesmen.

DETROIT ELECTRIC FURNACE CO., Detroit.—This company will show one of their standard type "C" 3000-pound capacity electric furnaces. The furnace will be set up for mechanical operation but no actual melting will be performed; represented by Ed. L. Crosby, H. M. St. John, A. E. Rhoads, F. L. Kavanaugh and other members of the organization.

DETROIT SOLUBLE OIL CO., Detroit.—It is the intention of this company to demonstrate by means of actual cores the application of its various core oils and binders. Represented by A. H. Pearson, F. N. Tweedy, F. L. Roades and F. Bobley.

DIAMOND CLAMP & FLASK CO., Richmond, Ind.—Exhibit will consist of several standard and master type flasks, steel jackets, bands, pattern makers benches, varnish cans, and a complete line

of foundry accessories; represented by E. A. Kinley and F. J. Gurtsiele.

DIAMOND OIL CO., Philadelphia.

DINGS MAGNETIC SEPARATOR CO., Milwaukee.—This company will show three machines in operation. One of these will be a magnetic separator used for reclaiming iron from gray iron, steel and malleable foundry refuse. Another will be a typical magnetic pulley type separator with bilge boards and deflecting boards, and a third will be a new development in the foundry industry. This latter machine is used for extracting iron from brass and bronze turnings; represented by A. H. Ackermann, J. E. Randall, P. R. Hines, and R. A. Manegold.

DISSTON, HENRY, & SONS, Philadelphia.—At this booth power hack saws and the sectional interlocked inserted tooth circular milling saws will be shown in actual operation. The interlocked milling saw is a patented design that has been developed by this company especially for cutting metal of irregular shapes, hard steel rails, risers and gates from steel castings, general structural steel work, etc. The teeth in this saw are so arranged that six teeth are absolutely locked in place with one wedge; this makes it possible to place the teeth close together, doing away with chattering caused by the wide spacing. Besides the saws in operation, the company will show metal slitting saws, milling saws, hand and power hack saw blades, screw slotting saws, and files of all kinds; represented by Messrs. Dorrington, Bardsley and Newman, and L. L. Mather.

DIVINE BROS. CO., Utica, N. Y.

DIXON, JOSEPH, CRUCIBLE CO., Jersey City, N. J.—Will show a complete line of crucibles for every purpose. Literature covering every phase of crucible manufacture and use will be distributed; represented by D. A. Johnson, H. C. Sorenson, F. A. St. John, R. R. Bellville, R. F. Leonard, L. S. Stapp, M. M. McNaughton, and A. L. Haasis.

DOGGETT, STANLEY, INC., New York.—Propose to exhibit samples of special parting and facing material and other foundry facings and supplies; represented by Stanley Doggett, Stanley H. Doggett, and Henry A. Roffman.

ELECTRIC FURNACE CO., Alliance, O.—This exhibit occupying two booths will consist, first of a 50-kilowatt tilting-type electric furnace for melting brass and aluminum, together with the necessary switch and transformer; second, numerous copper and brass castings which have been produced in foundries which employ electric furnaces for melting their nonferrous metals; third, moving pictures showing the furnaces in actual operation, both for melting nonferrous metals and for heat treating and annealing; represented by R. F. Fletcher.

ELECTRIC WELDING MACHINE CO., Detroit.

FEDERAL FOUNDRY SUPPLY CO., Cleveland.—Will exhibit a line of molding machines and specialties; represented by Ralph Ditty, Elsworth Kaye, W. J. Smith, John Bayer, W. A. Ghmitz, G. A. Fuller, T. H. Terry, C. A. Collins, T. R. Ditty.

FEDERAL MALLEABLE CO., West Allis, Wis.—At this booth will be shown one stationary squeezer, one portable squeezer and one jolt squeezer. These machines will be supplied with air and operated. They are planning to use several rather unique patterns in this connection and have prepared a set of patterns for soil pipe fittings and expect to show the soil pipe manufacturers something new in this line of molding; represented by W. J. MacNeill, G. J. Mead, and F. J. Bannach.

FERGUSON, H. K., CO., Cleveland.—The exhibit of the company will comprise models of foundry and machine shop buildings and others devoted to various uses. The booth will be decorated with photographs illustrating the scope of their activities and literature on the subject will be distributed; represented by E. Darrow and L. H. Butler.

FIREFOAM CO. OF OHIO, Cleveland.—Will show the following products: Forty-gallon chemical engine, 2½-gallon extinguishers, 3-gallon fire pail, 1-quart extinguishers, a complete line of safety cans and accessories. Demonstration will be shown at the booth and motion pictures will be shown of the company's product and appliances in action on various types of fires; represented by D. H. Reedy and E. E. O'Neill.

FOREIGN CRUCIBLES CORP., LTD., New York.—This exhibit will consist of a line of both brass melting and steel melting French graphite crucibles; represented by R. N. Stevens.

THE FOUNDRY, Cleveland.—This booth will be fitted up as a rest room and visitors may consider this booth their headquarters while in attendance at the convention and exhibition. A large assortment of technical books will be on display. Represented by John A. Penton, A. O. Backert, J. D. Pease, C. J. Stark, F. V. Cole, D. M. Avey, H. E. Diller, Pat Dwyer, Charles Vickers, E. L. Shaner, A. L. Klingeman, L. C. Pelott, S. H. Jasper, J. F. Ahrens and G. B. Howarth.

FOUNDRY EQUIPMENT CO., Cleveland.—Will have no equipment on exhibition. The booth will be fitted up as a rest room and will be decorated with photographs showing the company's activities; represented by F. A. Coleman.

GARDNER MACHINE CO., Beloit, Wis.—Will exhibit the following: Single and vertical spindle disk grinders; heavy duty disk grinder; polishing lathes, disks and accessories; represented by W. B. Leishman, W. L. Townsend, F. M. Risler, and E. L. Beisel.

GEIST MFG. CO., Atlantic City.—At this booth will be shown a piece of equipment for preheating castings that are to be welded; represented by Carlton Geist.

GENERAL ELECTRIC CO., Schenectady, N. Y.—An electric welding demonstration will be given in this space, other equipment will include a compressor driven by a 30 horse power 220-volt induction motor complete with compensator. The remainder of the space is to be used as general reception headquarters for General Electric customers; represented by C. T. McLoughlin, C. F. King, B. L. Spain, W. J. Snyder, K. Tsuda.

GORDON, ROBERT, INC., Chicago.—One of the heaters made by this company, equipped with an oil heater, will be kept in full operation during the exhibition; represented by T. H. Monaghan, H. H. Engle, J. L. Zimmerman, R. M. Zimmerman, C. H. Woodison.

GREAT WESTERN MFG. CO., Leavenworth, Kans.—This company proposes to exhibit various types of gyratory foundry riddles, also renewable bottom sieves for riddles; represented by F. A. Pickett, P. L. Wilson, George W. Combs.

GREAT WESTERN SMELTING & REFINING CO., Chicago.—Will exhibit a panel showing views of its various plants and branch warehouses throughout the world. The exhibit, itself, will be decorated and furnished along the lines of a reception room in a dwelling to entertain friends and acquaintances; represented by J. R. Neiman, H. J. Henry, B. J. Lippert, E. Q. Newman, S. M. Marks, I. N. Perlstein, Arthur Fritschle, H. L. Green, Mitchell Jacobs.

GRIMES MOLDING MACHINE CO., Detroit.—The company will exhibit molding machines, including a jar-ram, rollover machine of 1000 pounds lifting capacity, and a hand-ram, rollover machine with a rapidly operated pattern-change device; represented by G. L. Grimes, L. V. Grimes, C. J. Skeffington and T. M. McEuen.

GURNEY BALL BEARING CO., Jamestown, N. Y.—This exhibit will comprise a ball bearing journal box, adapted to be mounted in any standard shaft hanger. Also a ball bearing friction countershaft. The bearings used in this will be of the radio thrust type, adapted to carry both the radial loads and the thrust due to throwing in and out of the clutch; also ball bearings and adapters showing details of construction; represented by John T. R. Bell, J. H. Baninger, H. C. Marsh, D. K. Hatch, George C. Warner, H. C. Replogle.

HANNA ENGINEERING WORKS, Chicago.—Is planning to exhibit the following equipment: Rock over molding machine; 12-inch air jolt squeeze split pattern machine; 10-inch high trunnion jolt squeeze machine; 10-inch high trunnion squeeze machine; ½-inch, ¾-inch, 1-inch and 1½-inch vibrators; ¼, ½ and 1-ton trolleys; pneumatic hoists; suction oiler, vertical and universal types; two ⅝-inch small tripod shakers; represented by P. W. Gates, E. C. Welborn, A. F. Jensen, W. P. Krause, J. C. Hanna, J. O. Clark, O. F. Weiss and W. H. Huelster.

HARDINGE CO, New York.—Will show a patent conical mill with particular reference to its utility in the field of grinding and pulverizing of brass ashes, foundry wastes, mattes, slags, foundry facings, etc, both wet and dry. Working glass models will be used to illustrate the action of the mill; represented by James G. Parmelee and G. F. Metz.

HARDY, CLEMENT A., CO., Chicago.—This exhibit will consist of photographs and drawings of foundries which have been built and equipped by the company.

HARDY, F. A., & CO., Chicago.—A list of safety appliances which may be described as "everything for safety" will be shown at the booth of this company, represented by C. A. Kingsbury.

HARRIS BENJAMIN, & CO., Chicago.—At this booth will be shown red and yellow brass ingots, represented by Louis Goldman, William M. Rosenthal, Max Goldman, Dean F. Carscadden.

HASKINS, R. G., CO., Chicago.—The equipment shown at this booth will include portable tools, flexible shafting and machinery for grinding, polishing and drilling; represented by Fred J. Neubauer Co.

HAUCK MFG. CO., Brooklyn, N. Y.—Will exhibit a complete line of oil burning equipment for foundry use, such as portable and stationary ladle dryers, mold dryers; cupola lighters; crucible melting furnaces; crude, fuel and kerosene oil hand torches for general foundry use; furnace burners of all descriptions; complete oil burning outfits for converting coke and coal core baking ovens to fuel oil, a new blue flame kerosene burner for large and small ovens; blue flame stove for pattern shops; rivet and tool dressing forges; represented by A. E. Hauck, J. D. Moore, A. H. Stein, H. H. Kress, and F. E. Giersch.

HAYNES STELLITE CO., Kokomo, Ind.

HAYWARD CO., New York.

HEALD MACHINE CO., Worcester, Mass.—This company will exhibit a cylinder grinding a motor drive internal, a motor drive small internal and a motor drive rotary surface together with magnetic chucks and other accessories. The chuck will be shown in a water tank which demonstrates the water-proof qualities of a magnetic chuck; represented by J. F. Pflum, Mr. Heald, Mr. Massey and Mr. Johnson.

HILL-BRUNNER FOUNDRY SUPPLY CO., Cincinnati.—The booth for this company will be fitted up and furnished as a rest and meeting room for the convenience of friends and acquaintances; represented by Bruce Hill, M. Z. Fox, R. H. Mills, and John Hill.

HILL & GRIFFITH CO., Cincinnati.—A full line of foundry facing, equipment, platers, polishers and foundry supplies will be shown at this booth; represented by E. R. Ritter, William Oberhelman, P. L. Ritter, Fred J. Brunner, T. R. King, Robert B. Ferguson, J. J. Mayou Jr., J. H. Lyle, George H. Kersting, E. W. Sample.

HOEVEL MFG. CORP., Jersey City, N. J.—Will show sandblast barrel machine, sandblast table machine and sandblast room, furthermore, drawings, photographs and other descriptive material of their complete line of sandblast and allied equipment; represented by H. F. Hoevel, L. B. Passmore, J. Miller, and F. Welte.

HOLLAND CORE OIL CO., Chicago.—Various grades of core oils, parting compounds and dry core compounds will be shown, also photographic views of foundries in which these products are used; represented by H. L. Baumgardner, G. W. Doty, H. A. Whiting, S. Dykstra, J. B. McDonough.

HUMPHREYS, E. C., & CO., Chicago.—Will show a complete line of molding sand for iron, brass and steel castings; they will also have an attractive display of other materials which they handle, including iron ore and refractory materials of all kinds; represented by J. F. Mackin, C. E. Louis, and J. B. Eppink.

INDEPENDENT PNEUMATIC TOOL CO., Chicago.—Will show a complete line of pneumatic tools consisting of foundry chipping hammers; floor and bench hammers; hoists; air separators; pneumatic drills; and electric drills. The pistol grip and air separator are new; represented by W. A. Nugent.

S. W. Lanham, W. R. Gummere, H. F. White, V. W. Robinson and Adolph Anderson.

INDUSTRIAL ELECTRIC FURNACE CO., Chicago.—The principal feature of this exhibit will be a simple improved type of electric melting and refining furnace of 300 pounds capacity operating directly on a 220-volt motor circuit without transformers. It is suitable for melting and refining ferrous and nonferrous metals, any metal, that can be worked in cupola, open hearth, air furnace, crucible or other electric furnace. The remainder of the exhibit will comprise various pictures illustrating furnaces of several different types in operation; represented by F. von Schlegell, W. B. Lewis, W. B. Cooley, and L. C. H. Groeger.

INGERSOLL-RAND CO., New York.—In addition to a representative type of air compressor this company will also show a complete line of pneumatic tools, including motor hoists, sand rammer, riveting hammers, drills, grinding and cleaning machines, pneumatic hose couplings, etc.; represented by George J. Gallinger, Walter Johnson, W. A. Armstrong, George C. Williams, A. A. Anderson, and J. W. Anderson.

INTERNATIONAL MOLDING MACHINE CO., Chicago.—An entire line of machines consisting of squeezers, jolt squeezers, stripping squeezers, plain stripping plate machines, combination jolt strippers, plain jarring machines and combination turnover machines of several different designs will be presented to visiting foundrymen, represented by Edward A. Pridmore, W. W. Miller, F. W. Hamel, E. G. Borgnis.

INTERSTATE SAND CO., Zanesville, O.—This exhibit will consist of molding sand of all grades for iron, steel, brass, and aluminum castings; represented by E. M. Ayers and L. K. Brown.

IRON AGE, THE, New York.

IRON TRADE REVIEW, THE, Cleveland.—This booth will be fitted up as a rest room and visitors may consider this booth their headquarters while in attendance at the convention and exhibition. A large assortment of technical books will be on display. Represented by John A. Penton, A. O. Backert, J. D. Pease, C. J. Stark, F. V. Cole, D. M. Avey, H. E. Diller, Pat Dwyer, Charles Vickers, E. L. Shaner, A. L. Klingeman, L. C. Pelott, S. H. Jasper, J. F. Ahrens and G. B Howarth.

JENNISON-WRIGHT CO., Toledo, O.—The exhibit of this company will consist of photographs, etc., showing the adaptability of their wood blocks to foundry floors represented by A. W. Sharp.

JONES SAND CO., Columbus.—This company will exhibit a full line of iron, brass, aluminum and stove plate molding sands; represented by N. M. Jones.

JURACK PATTERN WORKS, CHARLES, Milwaukee.

KAWIN, CHAS. C., CO., Chicago.—This booth will be fitted up as a rest room and meeting place for their clients to visit, rest and possibly discuss some of their shop troubles; represented by Charles C. Kawin, John F. Nellis, J. H Hopp, R. F. Main, James Jordan, A. M. Knight, C B Teeter, H. P. Kreuden.

KEENER SAND & CLAY CO., Columbus.—This company expects to display a full line of foundry sands, fire brick, and clay; represented by H. A. Keener and C P. Helmick.

KELLER PNEUMATIC TOOL CO., Chicago.—Will exhibit a complete line of foundry hammers, floor sand rammers and bench sand rammers with both straight and pistol grip handles, valveless and corliss valve drills and grinders, chisels, accessories, etc., represented by William H. Keller, L. H. Olsen, W. H. Woody, T. D. Slingman, C. A. Bremmer, J. B. Corby, C. Humphrey, L. J. Wakefield, J. N. Stebbins.

KELLOGG, SPENCER & SONS, INC., Buffalo.—Booths No. 15 and No. 21, Building No. 1 are to be used for display of cores and castings, and also samples of different grades of core oil; represented by W. L. Goetz, A. P. Mason, J. N. Yaeger, L. G. Allen, E. L. Journeay, H. J. Strassberger.

KELLY, T. P., & CO., INC., New York.—The booth of this company will be fitted up as a rest room and meeting place, represented by Ray Sullivan, E. L. Schenck, and V. J. Rohe.

KILBOURNE & JACOBS MFG. CO., Columbus, O.

KING REFRACTORIES CO., INC., Buffalo.

KINSEY, E. A., CO., Cincinnati.—Will display three machines. Two of these machines will be operated by demonstrators. One will be a No. 2 high duty drilling machine, the other will be a horizontal boring machine. They will also have a 10-inch power squaring shear in the exhibit; represented by W. J. Miller, Dan M Martin and A. J. Brokaw.

KNOEPPEL, C. E., & CO., INC., New York.—Will have exhibited a model control board on which will be shown a graphic control installation, set up for actual foundry operations; represented by Irving A. Berndt and other staff members.

LAKEWOOD ENGINEERING CO., Cleveland. The exhibit of this company will consist of tier-lift truck, tractor and trailers, rocker dump car, and platform car. It is also planned to show photographs of the company's equipment in use in foundries; represented by O. W. Stiles, W. A. Meddick, W. S. Miller, and R. M. Jones.

LANE, H. M., CO., Detroit.—This exhibit will comprise photographs and drawings of foundries which have been designed and laid out by the company; represented by H. M. Lane, John A. Rathbone, A. O. Thomas, Benjamin Towlen, C. R. Seabrook.

LEWIS-SHEPARD CO., Boston.

LINDSAY CHAPLET & MFG. CO., Philadelphia.—A complete line of standard chaplets will be shown at this booth. Also special chaplets adapted to engine castings (automobile, gas engine, tractor) pumps, railroad castings (bolster and side frame castings); represented by Stanley B. Wentz and Herman E. Mandel.

LINK-BELT CO., Chicago.—A revivifier for molding sand will be shown in operation at this booth, also an electric hoist and a silent chain drive. Other interesting features will be enlarged photographs of foundries in which the company's equipment has been installed; represented by A. G. J. Rapp, R. B. Kern, E. C. Berghoefer, and J. S. Watson.

LOCKE PATTERN WORKS, Detroit.—Will have a complete display of modern pattern equipment for automobile, truck, tractor, airplane and farm implements; represented by D. H. Locke, E. A. Fleming, and David Bruce.

LOUDEN MACHINERY CO., Fairfield, Iowa. This company has engaged spaces Nos. 415, 416, 425 and 426 on which they expect to make a complete display of overhead track and trolley equipment for foundries, mills, warehouses, etc. The exhibit will consist of tracks, trolleys, switches, hand operated traveling cranes, swinging jib cranes, coal carriers, special hoists, special trolleys, etc.; represented by L. E. Gaston, William Buhl, J. P. Lawrence, C. E. Beattie, J. K. Davis, L. F. Berthold.

LUCAS MACHINE TOOL CO., Cleveland.—A 50 ton power forcing press designed for straightening steel and malleable castings will be shown at this booth; represented by F. P. Sprague.

LUDLUM STEEL CO., Watervliet, N. Y.

LUPTON'S, DAVID, SONS' CO., Philadelphia.—Will show samples of various products, including pivoted factory sash, a short run of Pond Continuous Sash with storm panels at each end, this line of sash will be equipped with Pond Operating Device showing actual width opening, Lupton Counter-Balanced Sash, steel partition, steel tube door, cross section drawings showing installation in some remarkable heat-producing buildings throughout the country of large size, also enlarged photographs of these installations; represented by Clark P. Pond, C. F. P. Buckwalter, R. A. Sanborn, William Pfleider, George J. Wagner.

McCORMICK, J. S., CO., Pittsburgh.—Among the exhibits of this company will be one facing and core sand mixer, one electro magnetic separator, one pattern letter machine, one pneumatic blacking mixer, also sundry supplies; represented by J. S McCormick, T E. Malone, S. R. Costley, E. M. Lewis.

McLAIN'S SYSTEM, INC., Milwaukee.—Will show semisteel liberty motor, gas, oil, engine pistons and cylinders, gears, bushings, etc., containing 20 to 50 per cent steel. Sample castings of annealed semisteel with a tensile strength of 55- to 70,000 pounds per square inch. Also steel castings made in McLain-Carter open hearth furnaces; represented by David McLain, I. V. Scanlan, and Fred Smith.

MACHINERY, New York.

MACLEAN PUBLISHING CO., Toronto, Ont., Canada.

MACLEOD CO., THE, Cincinnati, O.—Sand blast equipment, dust arresters, portable oil burners, and ladle dryers will be shown at this booth; represented by O. P. Gwinner, A. A. Anderson, Walter Macleod.

MAGNETIC MFG. CO., Milwaukee.—Will have exhibition two types of magnetic separators brass foundries, a magnetic separator for gray iron, malleable iron and steel foundries, also magnetic pulley type separator; represented by R. H. Stearns and G. H. Fobian.

MAHR MFG. CO., Minneapolis.—This company will exhibit foundry torches for mold drying, cupola lighting, ladle drying, etc., ladle dryers and heaters, oil fuel rivet forges, annealing furnaces and other oil and gas burning equipment; represented by W. G. Barstow, C. M. Simonds, and H H. Keeler.

MALLEABLE IRON FITTINGS CO., Branford, Conn.—An operating exhibit of all sizes of vibrators, sprayers and accessories made by the company will be shown at this booth, also a core bench in operation and a model of a new buggy ladle; represented by G. B. Pickop and Frank Boskey.

MARDEN, ORTH & HASTINGS, New York.—At this booth will be shown samples of liquid and powdered sand binder, together with cores bonded with this material; represented by G. N. Moore and A. L. Milner.

MAXON FURNACE & ENGINEERING CO, Muncie, Ind. Will exhibit and demonstrate fumeproof cover brass furnace and furnace linings, also a special line of burners and oil pumps.

MENEFEE FOUNDRY CO., INC., Fort Wayne, Ind.—A number of pattern mounts that have been in use for several years on molding machines will be shown, also a practical demonstration of how these pattern mounts are made; represented by James William Menefee and Earl H. Menefee.

MERCURY MFG. CO., Chicago.

METAL INDUSTRY, New York

METAL SAW AND MACHINE CO., INC., Springfield, Mass.—A machine for cutting steel of various kinds will be kept in operation during the entire exhibition; represented by M. T. Workman and H. F. Blanchard.

METAL & THERMIT CORP., New York.—Will have a display of various metals and alloys as produced by the alumino-thermic process. Important alloys such as those used in the production of high speed steel will also be shown. One special feature will be an exhibition of pure tungsten powder in tablet form. Transparencies and photographs will illustrate welding on heavy mill machinery and general repairs; represented by A F. Braid, H. G. Spilsbury, W. R Hulbert, and H. D. Kelley.

MICHIGAN SMELTING & REFINING CO., Detroit.—The exhibit will contain samples of brass and bronze ingots, billets and slabs, babbitt metals, solders, lead pipes, die castings, and brazing spelter; represented by John R. Searles, Norman Sillman, Henry Levitt, R. H. Evans, Charles Bloomgarden, and Charles T. Bragg.

MILBURN, ALEXANDER, CO., Baltimore.—Are setting up a working exhibition, showing acetylene generators for welding, oxyacetylene welding and cutting torches, new types of acetylene regulating devices, and kindred apparatus. The generator's range from 60-pound capacity, mounted on portable trucks, to large central installations for the commercial production, storage and distribution of gas for welding and cutting purposes. The company's unique combination welding and cutting torch, which both cuts and welds with equal facility, will be continuously demonstrated during the exhibition. Other blow-pipes and torches from the smallest jeweler's size up to the largest commercial torches will also be exhibited. A new regulator for the control and delivery of acetylene, oxygen, hydrogen, and various other gases will be exhibited for the first time. The regulator is smaller in size, more compact, of fewer parts, and much greater accuracy than former types. A large number of other apparatus, such as preheating burners, powerful portable acetylene lights

will be on exhibition: represented by J. A. Schleicher, D. Bartlett, C. E. Mitchell and E. P. Boyer.

MONARCH ENGINEERING & MFG. CO., Baltimore.—Will show the following equipment: One 1-ton motor driven revolving non-crucible furnace, one 600-pound crucible furnace, one double chamber, non-crucible furnace, one No. 150 crucible tilting coke ge. one No. 125 crucible tilting gas furnace motor blower, one No. 40 crucible stationary gas one vertical tilting, oil or gas furnace, hout crucibles, one No. 80 stationary crucible preheater air furnace, oil, one permanent mold machine (for brass and iron castings), one ladle heater, oil and gas, one oil mp, one positive pressure blower, core oven, o e core oven, coke, oil or gas; represented by D. Harvey, James J. Allen, Frank Maujean, James V. Martin, and William Haber.

MOTT SAND BLAST MFG. CO., INC.—One 8-foot revolving table, two different size tumbling barrels and an 8-foot dust arrester will be shown in operation at this booth every day; represented by David Mayer, E. J. Rosenthal, William Fischer, E. C. Gilmour, R. E. Donnelly, and P. R. Jones.

MUMFORD MOLDING MACHINE CO., Chicago.

NATIONAL ENGINEERING CO., Chicago.—Will exhibit one 6-foot diameter pan mixer which will be shown in actual operation, also one 4-foot diameter and 3 foot diameter mixers.

NATIONAL SCALE CO., Chicopee Falls, Mass.—Among the exhibits of this company will be a scale counting machine, elevating truck, call system and shelving, also a 500 series, dormant type counting machine, three bench type, complete installation of call system, from three to five stacks of steel stock bins and stock filing cabinet, universal lift truck and scale elevating truck; represented by E. C. Steele, Mrs. Steele, Mr. Trezevant, Mr. Mercer, Mr. White, and Mr. Schattinger.

NICHOLLS CO., WM. H., INC., Brooklyn, N. Y.

NORMA CO. OF AMERICA, New York.—This company will have a moving exhibit demonstrating the speed and silence at which their bearings operate; represented by R. E. Hecker, T. J. Harley, and D. E. Batesole.

NORTON CO., Worcester, Mass.—The exhibit of this company will consist of alundum and crystolon grinding wheels, grinding wheel stands, and refractories.

OBERMAYER, S., CO., Chicago.—Will exhibit small equipment, such as core ovens, sprue cutters, tumbling barrels, etc.; represented by S. T. Johnston, C. M. Barker, J. L. Cummings, J. E. Evans, William Fenton, William Fitzpatrick, E. D. Frohman, J. J. McDevitt, O. C. Olson, O. J. Peterson, A. N. Wallin.

OHIO BODY & BLOWER CO., Cleveland.—Will show a low temperature baking oven, portable racks, air separator, air trap and rotary ball bearing ventilator; represented by T. D. Johnson and at least one other of their direct men.

OHIO EQUIPMENT CO., Cleveland. This exhibit will consist of lift trucks, the latest design in core racks, automatic dial scales, and the gasoline shop mule. Material handling equipment of the latest design will also be shown; represented by W. R. Englehart, E. M. Abramson, Ed. Stuebing, and E. A. Thiele.

OHIO METAL CO., Columbus, O.

OLDHAM, GEORGE, & SON CO., Baltimore.—Will display a full line of chipping hammers, foundry rammers, core busters, scalers, riveters, holders-on, and jam riveters, together with a line of pattern gouging tools. The tools will be available for operation so that visitors can note the powerful cutting ability and smooth action; represented by C. H. Lyle, J. T. Biles, and F. R. Fraser.

OLIVER MACHINERY CO., Grand Rapids, Mich.—Nine varieties of woodworking machine tools will be shown in the space allotted to this company; represented by A. S. Kurkjian, M. D. Baldwin, R. F. Baldwin, James R. Duthie, Arthur Blake, C. A. Glister, G. C. Conklin, W. F. Reading, J. E. McLauchlen, Dolph de Young, Arie Steenbergen.

OSBORN MFG. CO., Cleveland.—A comprehensive list of molding machines will be shown by this company including direct draw roll over jolt machines; combination power jolt stripper squeezer machine, large type; combination jolt stripper machines, small type, not power driven; plain air squeezer machines; air squeezer jolt machines, several small roll over machines. Many of these machines will be equipped with patterns and the making of molds will be demonstrated; represented by H. R. Atwater, J. C. Alberts, E. J. Byerlein, E. S. Carman, Ward Daughterty, H. E. Deakins, E. T. Doddridge, E. W. Jacobi, R. E. Kiefer, H. A. Potter, F. T. Spikerman, P. F. Troyan.

OSBORNE & SEXTON MACHINERY CO., Columbus, O.—In addition to a lathe and shaper made by the company there also will be shown several tools made by other manufacturers; represented by C. A. Fisher.

OXWELD ACETYLENE CO., Chicago.—Will exhibit an oxweld low pressure generator and oxweld welding and cutting apparatus and demonstrate the application of their equipment. In addition they will demonstrate the cutting of cast iron; represented by L. E. Ogden, G. Hettrick, T. Gillespie, C. E. Downey, Carl Olson, R. J. Kehl, H. C. Mace, J. C. Reid, G. F. Schmid.

PAINE & CO., Wilkes-Barre, Pa.—It is the intention of this company to put an oven in its booth for making cores; it also will make a display of oil binders. The booth will be fitted up with chairs for a rest room; represented by J. W. Shotts and James F. Besecker.

PANGBORN CORP., Hagerstown, Md.—Castings in various sizes and metals will be cleaned daily with exhibit of castings, forgings, heat treated parts, enameled work, etc., before and after sand blast treatment. One section will be comfortably furnished and supplied with drawings, literature, etc., for convenience of interested foundrymen, with photographs of different types of equipment as actually installed in prominent plants throughout the country; represented by Thomas W. Pangborn, John C. Pangborn, W. C. Lytle, Jesse J. Bowen, George H. Cooley, Charles T. Bird, P. J. Potter, James F. Tracey, Roy C. Koch, W. A. Allbright, A. G. Hauck, John Abbott, H. D. Gates, Hugo F. Liedtke, and Foster J. Hull.

PAXSON CO., J. W., Philadelphia.—Will exhibit various lines of molding sands and supplies. Equipment will be represented by drawings and photographs, represented by H. M. Bougher and I. F. Kremer.

PENTON PUBLISHING CO., THE, Cleveland. The complete list of periodicals published by this company will be on display, including THE FOUNDRY, *The Iron Trade Review*, the *Daily Iron Trade and Metal Market Report*, *Abrasive Industry*, *Marine Review* and *Power Boating*. In addition this company will exhibit a large number of technical books. Represented by John A. Penton, A. O. Backert, J. D. Pease, C. J. Stark, F. V. Cole, D. M. Avey, H. E. Diller, Pat Dwyer, Charles Vickers, E. L. Shaner, A. L. Klingeman, L. C. Pelott, S. H. Jasper, J. F. Ahrens and G. B. Howarth.

PICKANDS, BROWN & CO., Chicago.—In connection with the Semet-Solvay Co., expect to make an attractive display of Solvay foundry coke; represented by R. S. Dutton, Thomas W. Glasco, A. Galligan, F. L. Schulze, George A. T. Long, W. H. Ball, and James A. Ballard.

PITTSBURGH CRUSHED STEEL CO., Pittsburgh.—This exhibit is to be conducted under the auspices of the "Metallic Abrasive Manufacturers' Association of America." The association will exhibit metallic abrasives for sand-blasting and will show samples of steel grit, the sharp angular abrasive and of chilled shot the globular abrasive; represented by G. H. Kann, H. M. Ream, N. C. Harrison, R. S. Kann.

PORCELAIN ENAMEL & MFG. CO., Baltimore.—Expect to demonstrate genuine porcelain enamel application on cast iron.

PORTAGE SILICA CO., Youngstown, O.—Will consist of samples of conglomerate silica rock in its natural state, and samples of various grades of sand blast, steel molding and core sands; represented by E. E. Kloos and L. R. Farrell.

PRIDMORE, HENRY E., Chicago.—Will have the following molding machines in operation with patterns and flask, and will make molds on each machine: 30-inch combination, jolt, roll-over equipped with cylinder pattern, 26 x 24-8-inch drop power rock-over drop machine equipped with pattern and flask, 18 x 20-inch combination jolt strip equipped with pattern and flask, 10 x 14-5-inch drop rock-over machine with pattern and flask, 14 x 14-inch, square-stand, machine equipped with cope pattern, 10-inch, jolt squeezer with pattern and flask; represented by Mrs. E. M. Pridmore, Henry A. Pridmore, George Furman, Henry G. Schlichter, Marshall E. Pridmore, Hebert Behrens, D. F. Eagan, C. H. Ellis, J. W. Dopp, J. A. Patterson, and Hugh Gallagher.

QUIGLEY FURNACE SPECIALTIES CO., New York. Exhibit comprises demonstration and photographs of high temperature cement and a highly refractory fire sand for bonding refractory materials including its use for furnace linings, cupolas, foundry ladles and for manufacture of special shapes and rammed in linings as well as repairs to furnace structures, an air transport system for preparing, distributing and burning powdered coal will be shown by means of photographs; represented by W. S. Quigley, J. H. McPadden, F. W. Reisman, H. H. Harris, W. A. Toohill, and W. C. Bell.

RACINE TOOL & MACHINE CO., Racine, Wis.—A motor driven high speed metal cutting machine and probably a new slotting machine of the milling type will be shown; represented by W. R. Reinhardt, A. H. Goetz, F. J. Kidd.

RAILWAY MECHANICAL ENGINEER, Chicago.

RAYMOND BROS. IMPACT PULVERIZER CO., Chicago.—Will show a model roller mill which is being used so extensively nowadays for powdering coal used in the foundry industry. This mill will be in operation, grinding coal to illustrate the fineness and uniformity of the product, also how well the mill operates and how dustlessly it handles the material; represented by Joseph Crites and F. I. Raymond.

RICHARDS-WILCOX MFG. CO., Aurora, Ill. number of models will be shown at this booth to illustrate the advantages and general features of conveying equipment; represented by A. J. Eggleston, E. J. G. Phillips, Frank H. Wente, and J. A. White.

ROBINSON, DWIGHT, & CO., Buckhill Falls, Pa.—Convention will be attended by foundry engineers who will exhibit photographs of foundries designed and constructed by the company.

ROGERS, BROWN & CO., Cincinnati.—The company's booth this year will be equipped with a large map electrically operated showing the location of its various sources of supply, such as blast furnaces, coke, fluorspar, iron ore and magnesite districts; J. C. Mears, St. Louis; A. O. Sonne, Chicago; L. E. McClaren, Chicago; S. W. Hubbard, Cleveland; C. P. Hellwig, Cleveland; T. A. Wilson, Pittsburgh; C. D. Shepard, Pittsburgh, F. J. Waldo, Buffalo; A. F. Stengel, Buffalo; R. T. Melville, Buffalo; G. R. Maher, Boston; R. W. Clark, New York; G. R. Sullivan, Philadelphia; S. B. Morison, Philadelphia; F. W. Bauer, Cincinnati; A. J. Wentworth, Cincinnati, F. I. Teal, Cincinnati, L. W. Hoefinghoff, Cincinnati, F. W. Miller, Cincinnati; J. R. Morehead, Cincinnati.

ROOTS CO., P. H. & F. M., Connersville, Ind.—Will show the first Roots blower ever constructed and also an up to date machine of small size, a small blower and small gas pump; represented by H. M. Papworth, C. C. Abbott, E. D. Johnston.

SAFETY EQUIPMENT SERVICE CO., Cleveland.—Exhibit comprises goggles for chipping, grinding, welding, dust, smelters, acid; a complete line of hospital equipment; gas and electric sterilizers; a complete line of first aid supplies and accident kits; bulletin boards; shaft oilers; belt sticks; carboys; set screws; safety cans, machine guards; individual towels and drinking cups; sanitary drinking fountains; wash stands; lavatories; playground equipment; safety clothing made of asbestos; rubber; leather; fire, water and acid proofed material, including

pants, gloves, mittens, leggins, aprons, a garment for every industrial use; respirators, shields, hoods, masks, helmets for dust, sand-blasting, babbitting and welding; emery wheel, jointer and shaper guards; signs and tags for that danger, caution or warning spot; represented by B. W. Nutt, B. Frank; H. L. Wood, and T. P. Scully.

SAFETY FIRST SHOE CO., Providence, R. I.—This company will show two lines of shoes specially designed along safety lines for use in foundries and other industries of a like character; represented by Edgar C. Davidson.

SIMONDS MFG. CO., Fitchburg, Mass.—Will have a working exhibit demonstrating metal cutting-off saws. The special feature of the exhibit is an inserted tooth metal cutting saw, different sizes of which are shown and operated on the machines. These saws are made with high speed steel cutting teeth fitted into a carbon plate. Different size teeth are made for cutting different materials and give different widths of cutting kerf. The exhibit also includes files and hack saw blades made by this company; represented by H. B. McDonald, G. R. Bird, and H. Baumann.

SLY, W. W., MFG. CO., Cleveland.—Will show a 2-section drawer type core oven complete in every detail; represented by W. C. Sly, E. J. Moore, D. E. Hadley, P. W. Graue, S. H. Baird, F. A. Ebeling, and G. K. Farmer.

SMITH, H. P., & SONS, Chicago.—Will confine their exhibit to a display of safety shoes for molders and foundrymen; represented by J. B. Smith Jr.

SMITH, WERNER G., CO., Cleveland.—This exhibit will consist of samples of core oils of their own manufacture, specimen cores made with their oils, and castings in which cores made with their oils were used; represented by Werner G. Smith, Frank H. Dodge, Milton S. Finley, A. L. Robinson, William E. Rayel, Louis F. Ferster, J. C. DeVenne, Norman A. Boyle, F. K. Sawyer, John Scheuer, Charles G. Cook, and W. R. Collette.

SPENCER TURBINE CO., Hartford, Conn.—The exhibit will consist of the Spencer turbo-compressors as used for foundry cupola blowing, and for supplying air for oil and gas burning furnaces; represented by H. M. Grossman and S. E. Phillips.

STANDARD EQUIPMENT CO., New Haven, Conn.—Will exhibit radial blast barrels in three sizes and one standard cinder mill. The radial blast barrel and the cinder mill will be in operation daily; represented by C. A. Dreisbach, C. S. Johnson, F. Washburn and J. R. Sheldon

STANDARD SAND & MACHINE CO., Cleveland.—Will show a standard facing and core sand mixer, represented by H. E. Boughton

STERLING WHEELBARROW CO, Milwaukee.—This exhibit will consist of a large and most attractive display of rolled steel flasks, special foundry wheelbarrows, and other specialties, such as shop boxes, trucks, skim gates, wedges, etc.; represented by I. R. Smith, H. H. Baker, A. E. Welch, R. F. Jordan, J. J. Coyne, J. M. Dickson, O. E. Steep, G. H. Lambkin, J. W. Dopp, J. M. Patterson, Herman Kalthoff, Leo Hartwell, and E. C. Mueller.

STEVENS, FREDERIC B., Detroit.

STODDER, W. F., Syracuse, N. Y.—Will show a suction sand blast nozzle designed to eliminate the use of pressure tanks; represented by W. F. Stodder and M. A. Stodder.

SULLIVAN MACHINERY CO., Chicago.—Will exhibit one of its angle compound belt-driven air compressors. This machine will be operated by a 75-horsepower General Electric motor and will supply air, as at previous expositions, for other exhibitors at the foundry show, will be equipped with standard and rolling finger type of plate valve. The Sullivan exhibit will also include one 10 x 10 straight line, single stage belt driven air compressor, enclosed working parts and splash system of lubrication, one auger drill used for breaking cores in foundries, also a utility forge hammer for miscellaneous light forging; represented by R. T. Stone, E. T. Wells, H. T. Walsh and S. B. King.

SUPERIOR SAND CO., Cleveland.—Samples of molding sand suitable for all classes of castings in iron, brass, steel, aluminum, etc., will be shown at the booth of this company; represented by W. H. Smith and H. C. Koontz.

TEETOR CO., R. J., Muskegon, Mich.

THOMAS ELEVATOR CO., Chicago.—Will exhibit a line of wrenchless chucks; represented by A. W Boldebuck and J. J. Moore.

TORCHWELD EQUIPMENT CO, Chicago.—Will show a complete line of torchweld products, such as welding apparatus, cutting apparatus, preheating apparatus, and everything that interests the metal welding industry. Many new features in cutting equipment will be introduced, including a machine welding torch, a machine cutting torch, and also a number of new ideas for increasing the efficiency and economy of these particular items; represented by W. A. Slack, H. R. Fenstemaker, C. J. Nyquist, and George Smedley.

TRUSCON STEEL CO., Youngstown, O.—The exhibit will consist of pressed steel foundry flasks; a pressed steel platform for lift trucks; photographs and layouts of various types of industrial buildings, and side wall steel windows, top hinge continuous monitor steel sash and a tension operating device.

UNITED COMPOUND CO., Buffalo.—This exhibit will comprise samples of the material and also demonstrations of its application; represented by John W. Bradley and L. F. Leney.

UNITED STATES GRAPHITE CO., Saginaw, Mich.—The exhibit will consist of a display of graphite and graphite products for the foundry trade. They are planning on making a practical demonstration of foundry facing and expect to have something in the way of a souvenir for distribution to the trade at this gathering; represented by H. F. Gump, Charles H. Schenck, J. G. Drought, C. D. McIntosh, R. J. Edmiston, and A. S. Harvey.

U. S. MOLDING MACHINE CO., Cleveland.—Expect to exhibit a number of molding machines, including plain air squeeze machine, jar and squeeze machine, jar squeeze pattern drawing, jar squeeze roll over, jar pattern drawing machine, jar roll over pattern drawing, plain jar machine. All of the machines will be operated making molds; represented by J. N. Battenfeld, J. L. Battenfeld, C. F. Battenfeld, and Harold Klinkler.

UNITED STATES SILICA CO., Chicago.—This exhibit will comprise samples of flint shot for sand blasting and flint silica for steel molding and core making, also samples of castings produced with these materials, also printed matter regarding plant operation and results obtained by flint shot; represented by Volney Foster, Lewis B. Reed, H. F. Goebig, and Oliver Cook.

UNITED STATES SMELTING FURNACE CO., Belleville, Ill.—Rotary melting furnaces for melting brass, bronze, aluminum; for smelting and refining work and for melting vitreous enamels will be shown in capacities of 200, 400, 1000 and 2000 pounds; represented by Arthur Jones

VIBRATING MACHINERY CO., Chicago.—Will have a complete battery of special electrical sand sifters in operation during the show; represented by Julius Schroeter and William Lindsay.

WADSWORTH CORE MACHINE & EQUIPMENT CO, Akron, O.—Booths occupied by this company will be more in the form of a reception room or office. It is proposed to exhibit but not demonstrate, special 3-spindle motor driven core making machine; also 1½-inch core cutting off and coning machine, for cutting off and coning cores from ½-inch to 4 inches, and quite a few various sizes of all steel core drying plates and bottom plates; represented by George H. Wadsworth, M. C. Sammons, and L. L. Crane.

WALLACE, J. D., & CO., Chicago.—Will have an exhibit of the 4-inch bench planer, 6-inch bench jointer, universal bench saw, plain bench saw, and a 14-inch bench band saw; represented by J. D. Wallace, H. L. Ramsay, D. H. Shartle, Henry Imshang, and James Stewart.

WARNER & SWASEY CO., Cleveland.—Machine tools will be shown at this booth including a universal hollow hexagon turret lathe, motor driven, with Lavoie air chuck, shown in actual operation; and a double friction back geared turret lathe, motor driven, also with Lavoie air chuck, holding a cone gear, with operating time of from 3 to 3½ minutes each; represented by R. G. Buyer, C. E. Neubert, C. B. Phillips, and L. K. Berry.

WAYNE OIL TANK & PUMP CO., Fort Wayne, Ind.—Will exhibit oil burning furnaces for brass melting of both the tilting noncrucible and crucible types; represented by S. D. Rickard, A. P. Hitzeman, and E. B. Lipsett.

WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburgh, Pa.—The exhibit of this company cludes one 150 kilowatt synchronous generator, single phase 60-cycle transformers, one 175 single operator welding unit, also several types of motors, controllers, switches, shields, electrode holders, adaptors, lenses, etc; represented by W. H. Patterson, W. W. Reddie, A. M. Candy, F. D. Egan, and G. H. Jaspert.

WESTINGHOUSE TRACTION BRAKE CO, Pittsburgh.—Expect to have on exhibition the following apparatus: Air compressors, motor and steam driven; detail accessories, such as pressure governors, cutout cocks, operating and control valves, air reservoirs, etc., represented by F. C. Young, S. A. King, M. H. Burchard, L. M. Pease, O. H. Miller, and J. B. Wright.

WHEELER, F. H., MFG. CO., Chicago.—Will show a complete line of protective apparel, spring knee leggins; springless leggins and hip leggins; spats, asbestos gloves, lined and unlined; asbestos mittens; one finger mittens; aprons; and complete line of wearing apparel, with many new articles and general improvements of the whole line; represented by F. H. Wheeler, E. L. Wheeler, and G. E. Pratt.

WHITE & BROS., INC., Philadelphia.—This exhibit will consist of casting copper-composition and bronze ingot metals, manganese bronze, yellow brass ingot metals, babbitt metals, and all nonferrous ingot metals; represented by Frank Krug, Raymond Hunter, Horace Krider, L. D. Kluver, and Frederick A. Reinhardt.

WHITEHEAD BROS. CO., Buffalo.

WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill.—One worm geared crane ladle of 4000-pound capacity, one iron charging car of 4000-pound capacity, one tumbler, 30 x 48, one model of trolley will be shown at this booth; represented by R. H. Bourne, A. H. McDougall, G. P. Fisher, R. S. Hammond, A. W. Gregg, and R. E. Prussing.

WHITMAN & BARNES MFG. CO., Akron, O.—Will display drills and reamers of all types and will have a grinding machine in the booth for the purpose of showing how to properly grind drills; represented by George R. Hume, R. A. Ammon, H. E. Fisher, George D. Ceska, H. Z. Callender, and H. B. Garske.

WRIGHT MFG. CO., Lisbon, O.—The line of exhibit will include chain hoists and trolleys; represented by S. J. Woodworth, R. C. Blair, H. F. Wright and H. H. Wright.

WOODISON, E. J., CO., Detroit.—The exhibit will include a full line of molding machine and core making machines, core box drawing machines, core blowing machines, crucible and iron pouring devices, back bone wax fillet, foundry supplies, facing, and platers and polishers' supplies and compositions; represented by E. J. Woodison.

WOOD'S, T. B., SONS CO., Chambersburg, Pa.—Will exhibit equipment for the Wood system of taper snap molding, comprising the Peerless Patented Tapered Snap Flask and Automatic Adjustable Patented Snap Jacket. Flasks and jackets will be shown in various sizes adapted for a wide range of snap work; represented by Charles M. Wood and Victor Lesher.

WRIGHT MFG. CO., Lisbon, O.

YOUNG BROTHERS CO., Detroit.—This exhibit will show a two-compartment rack type core oven, duplicating an Indiana installation. One compartment shown for gas and oil heat, the other with electric heaters. Photo projector will be installed for illustrating installations throughout the country; represented by George A. Young, R. B. Reed, V. A. Fox, E. P. Meyer, G. G. Parry, T. P. McVicker, A. H. Aehrmann and T. Lydon.

Builds Shop Where Roads Converge

Fig. 1—Locomotive water scoop casting

Farsighted Judgment Years Ago, Saving Factor Under Present Stress—Steel Plant Favors Jar-Ram Molding Machines For Varied Production—Handling Problems Solved

Fig. 2—Driving cellar casting

AFTER the armistice, businees faltered and there was stagnation in the industries of the country. Then the automobile industry, fed by the profits many had made during the war, became active and introduced a wave of prosperity which continued to expand until the foundation of the economic structure began to tremble under the strain. This weakening was seen in growing inability to secure materials of all kinds, and the situation finally became so acute that work on the superstructure of luxuries was curtailed and the country decided it must do what it should have done in the beginning—strengthen the foundation by reinforcing the transportation systems of the country in order that prosperity may go ahead without danger to the economic system.

The foundries of the country were strongly affected by the general transportation situation with its threatened strangling of the inflow of pig iron, coke, sand and other materials, and the difficulty of shipping the products of the shop. It is easy to see that without proper delivery facilities the foundry is badly handicapped. This lesson has emphasized the importance both of railroad transportation into and out of the foundry and also of internal movements of materials and castings in the shop, especially in handling sand.

EVERY industrial establishment has impressed upon it the mark of individuality of some one or more of its executives. Conversely a closer acquaintance is possible when something is known of the life work and accomplishment of a person whom one meets away from his daily environment. The accompanying article presents an exceptional steel foundry which is actively directed by Carlton S. Koch, the president of the American Foundrymen's association. It is offered at this time in the hope that it may make foundrymen better acquainted with the head of their organization.

The value of efficient freight facilities for the foundry has been appreciated by C. S. Koch, president and general manager, and H. J. Koch, secretary and sales manager of the Fort Pitt Steel Casting Co., McKeesport, Pa. Transportation first was considered years ago when the plant was located. Among the several reasons why McKeesport was selected as the home of the company was wide railroad advantages at hand. The Baltimore & Ohio railroad runs along the northern edge of the company's property and is paralleled by an industrial track which extends along the east side of the buildings, as may be noted in Fig. 4. This road affords shipping facilities east and west and connects with the Buffalo, Rochester & Pittsburgh railroad which taps the territory to the north. In addition to the direct contact with the Baltimore & Ohio, the plant is near the Pennsylvania and the Pittsburgh & Lake Erie railroads. Ad-

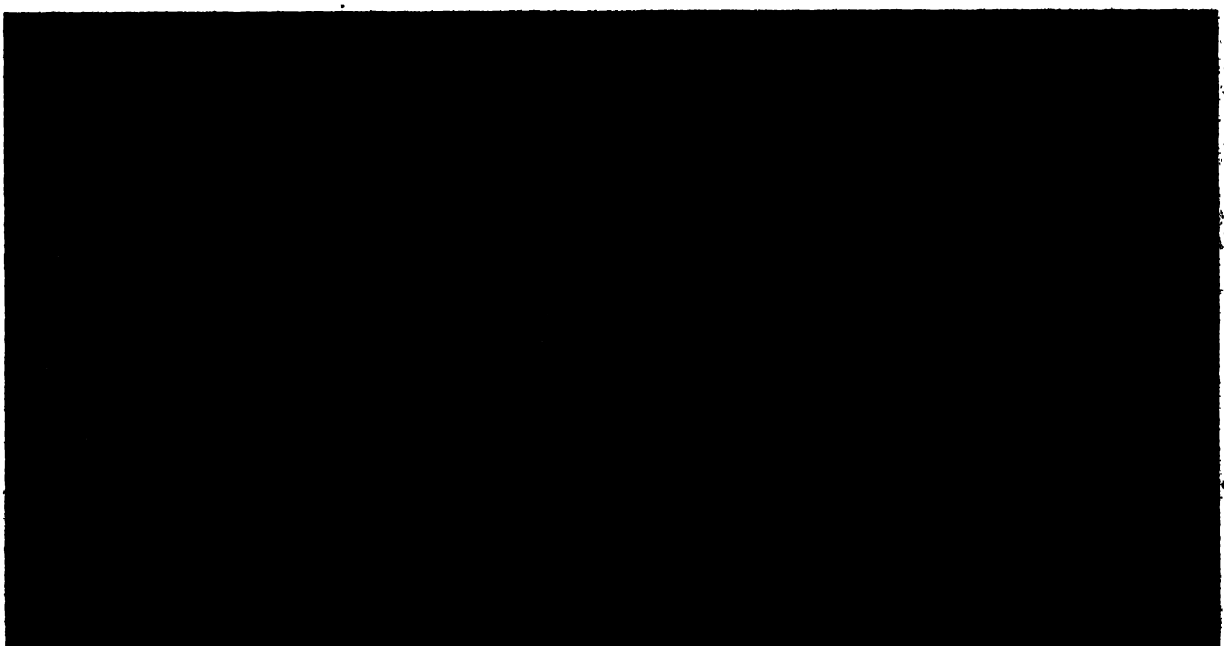


FIG. 3—SAND IS BROUGHT TO ONE SIDE OF THE MIXER IN DUMP BOXES—AFTER PASSING THROUGH THE MIXER IT FALLS INTO A BOX CARRIED ON A LIFT TRUCK AND IS CONVEYED TO THE MOLDING FLOOR

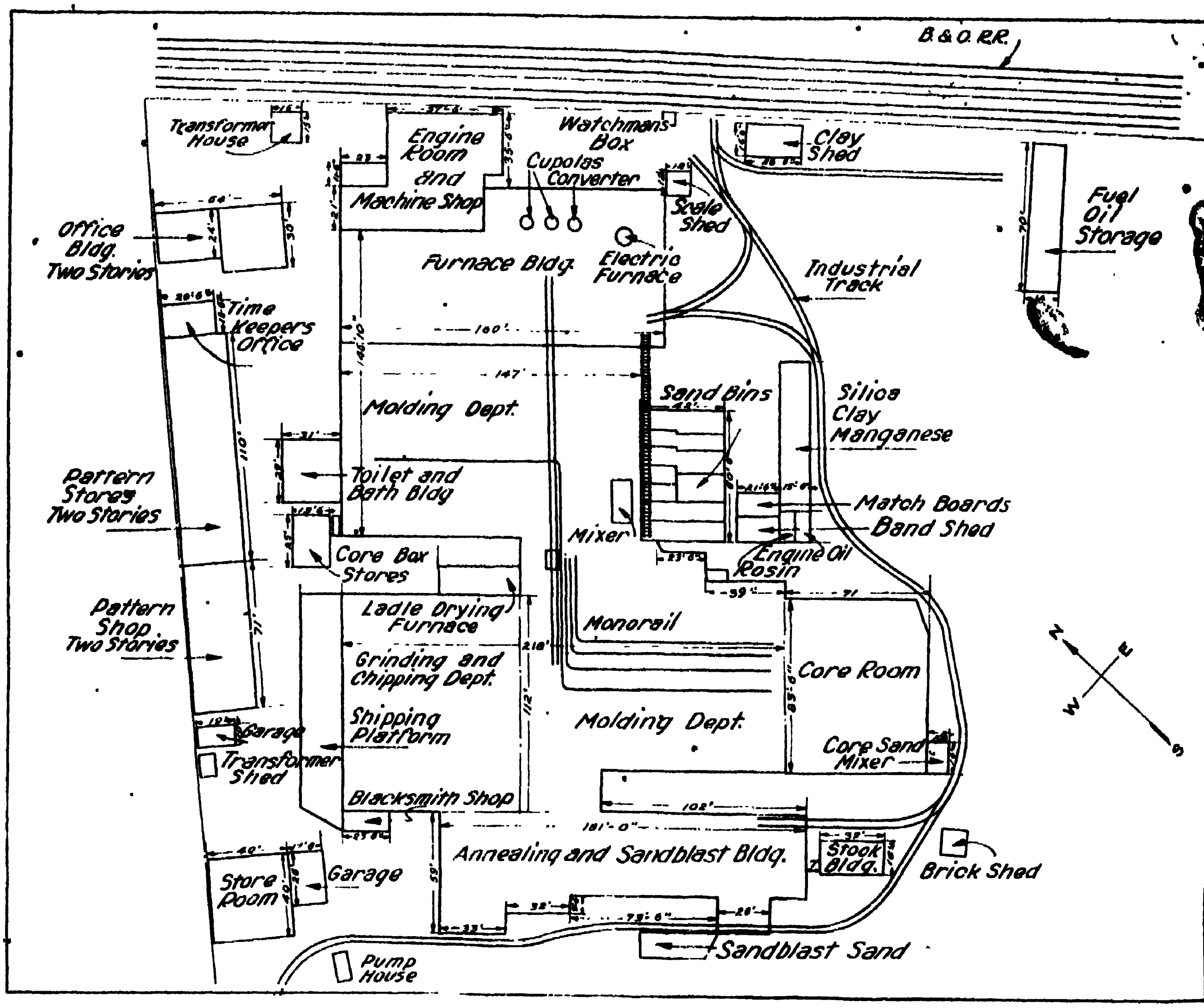


FIG. 4—THE FOUNDRY CONSISTS OF A GROUP OF FIVE PARALLEL BUILDINGS LOCATED BESIDE THE RAILROAD RIGHT-OF-WAY—AN INDUSTRIAL TRACK FROM THE FURNACE ROOM TO THE POURING STATION SERVES TO CONVEY THE MOLTEN METAL TO THE MOLDING DEPARTMENT

vantage is taken of this proximity to truck materials to and from these lines. Through the Pittsburgh & Lake Erie railroad connections, the New York Central system, the Erie railroad, and the Western Maryland railroad are reached. The Pennsylvania railroad, of course, opens up a wide territory both east and west.

To understand the system of transportation and conveyance within and about the plant the location of the buildings should be noted. The general layout is shown in Fig. 4. Here it may be seen that there is a cluster of five distinct buildings around which are scattered a number of smaller buildings such as the pattern shop and storage building, the office building, store room, etc. The five buildings in the main group extend parallel to each other. The annealing and sandblast building is shown in the lower part of the illustration. The building next above it contains the core room, the grinding and chipping department, and a portion of the molding floor. The third houses the remainder of the molding floor together with the sand-storage bins. Above this is the furnace building, and the machine shop and engine room are at the end.

Served by Industrial Track

Pig iron and sand are unloaded along the railroad track which parallels the company's property on the one side. An industrial track serves to convey these materials to the foundry. The sand is taken to the elevated track which runs over the sand bins. The car containing the sand is lifted to this track by an elevator and dumps the sand into separate bins as desired.

Stock for the furnaces is brought to the furnace room on cars. When the metal is melted and ready to pour it is carried to the pouring station between the two molding floors on the track, Fig. 4. It may be noted that the sand mixer is located in front of the sand bins, adjacent to both molding floors. This minimizes the distances by which the sand is carried to and from the molding floors. Both molding floors are conveniently located with respect to the grinding and chipping department. This arrangement of parallel buildings has another advantage besides that of bringing the different departments near to each other, thus minimizing the distances for conveying metal, sand and castings. This other advantage is seen when it is desired to extend any department. If more molding floor space is required it is only necessary to lengthen one of the buildings, and this can be done without disturbing the remainder of the shop.

An illustration of this feature recently was given when it was decided to install an electric furnace. All that was necessary was to lengthen the furnace building 60 feet, and no other part of the shop was discommoded. The furnace room now contains two 2-ton side-blow converters and two cupolas for melting the converter charge. Only one of the cupolas with its converter is operated the same day, and as three

heats can be made in an hour this converter has plenty of capacity for the requirements of the shop which is equipped for making 500 to 600 tons of castings a month. As many as 30 heats have been taken off in 10-hour day.

Few castings are made which weigh over 25 pounds. The general run castings is of light weight, intricate design, with extremely thin sections and is primarily for electrical machinery, lifting jacks, oil well supplies, motor trucks, rolling mills and for the lighter parts for locomotives, cars and railroad equipment.

Although the converters have given satisfaction and turn out metal which ran into the finest castings and does not crack, even though brackets are not used in many angles where the cooling strains are excessive, the company has decided to install a 3-ton heroult electric furnace. This is regarded as an experiment and only one of the converters will be dismantled. Some new features will be tried on the electric furnace and it is hoped that advantages will be obtained.

Carbon Contents Regular

Metal is taken from the converter at intense heat and with great regularity as to carbon contents. Ferromanganese is added to the bath before it is poured from the converter. Ferrosilicon is added in the ladle. Both of these alloys are used in the solid state. The ferrosilicon is heated somewhat before the molten metal strikes it, by adding it to the ladle as soon as the metal from the previous heat has been poured into the molds. Two ladles are used alternately. This allows the ladle with the ferrosilicon in it to be heated under a gas or oil flame after each second heat. The ladles are 2-ton capacity and the entire converter charge is poured into one ladle which is carried on a buggy having brackets at each end for the trunnions of the ladle to rest upon. The buggy is pushed to the pouring station by a tractor on a track which is shown near the center in Fig. 4.

Fig. 5 shows the ladle at the pouring-off station. When the tap ladle is brought to this place the slag is pulled off. The first metal from the buggy ladle is caught in hand ladles held by the men who pour it. The hand ladle when filled is hung on the hooks suspended from a monorail and this is carried to the molding floors. After some of the metal has been poured from the buggy ladle it no longer is necessary to lift the hand ladle from the monorail carrier, but the carrier can be pushed near enough to the buggy ladle to receive the metal from it.

This monorail extends from in front of the pouring station to both of the molding floors. Seven men pour off; three take the metal to the one molding department and four carry it to the other molding section. When not pouring, these men help to clean floors. Another gang of seven men shake out the castings, while four men are employed to keep the ladles in condition and pour the big ladle. The molders and machine men do nothing but mold. All casting are removed from the foundry at night. In the morning the men who later pour the metal, fill dump skids with about 40 per cent of the sand. These skids are taken to the sand mixer which is located between the molding floors. Here they are dumped until the pile of sand becomes too high, after which the skids are allowed to stand near the mixer until needed. The skids are conveyed by electric lift trucks of which the company uses three. These trucks together with the tractor and a few hand-operated lift trucks, supply practically all the locomotion for materials inside the shop.

Mixer Works Continuously

The sand mixer is operated continually all day. Three men shovel the sand into a bucket which lifts on a bearing and shoots the sand into the mixer. Old sand is mixed with new in the proportion of 45 to 10 or 15 depending on the work for which the sand is to be used. One part by volume of fireclay and the same amount of flour is added to this mixture, together with enough water to give it the proper temper. Sand is dropped directly from the mixer into dump boxes which are carried to the molding floors. This sand is used as facing by the molders.

The mixer may be seen in Fig. 3. To the left a truck is dumping a load of sand and to the right another may be seen placing a box in position to receive a load from the mixer. The hopper for charging the mixer is raised for discharging a load of sand. The same trucks carry refuse sand to the dump on company land. A different system for handling the sand is being tried by the company. With the new system each molding floor is supplied with three rows of skids. Each skid holds six molds of the average size which is about 14 x 17 inches. The molder fills one row of skids and while he is filling

FIG. 5—METAL IS BROUGHT TO THE POURING STATION IN A LADLE CARRIED ON A BUGGY—FROM HERE IT IS CARRIED TO THE MOLDING FLOORS ON MONORAILS

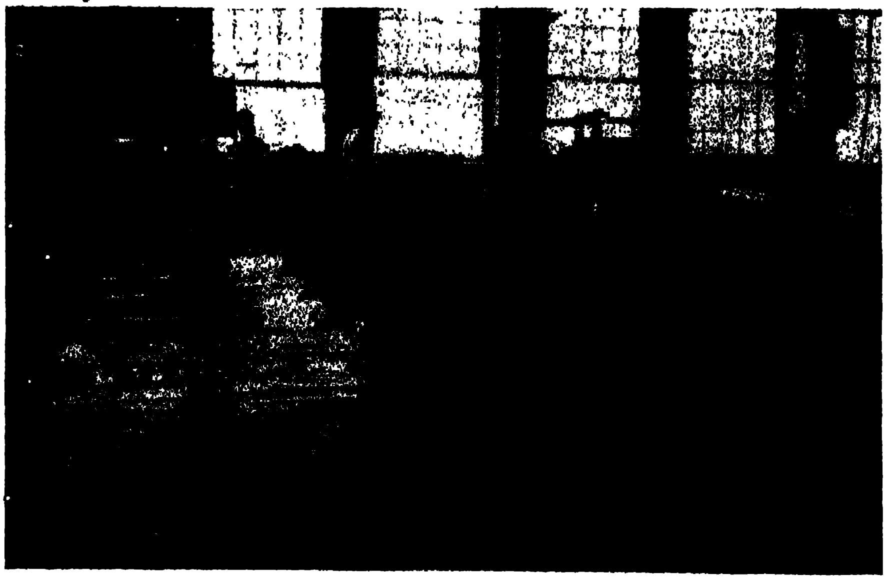


FIG. 6—ONE MOLDER MAKES THE DRAG AND THE OTHER THE COPE—CORES FOR THE DRAG ARE SET ON A RACK NEAR THE MOLDER—MOLDS ARE PLACED ON SKIDS

the next row the molds in the first row of skids are poured and the flasks taken off and piled near the molder's bench. Then when the molder is filling the third row of skids, flasks are taken from the second row, and skids in the first row are carried by the electric lift trucks to a portion of the floor where the sand and castings are dumped. The skids are then taken back to the molding floor and formed into a new line for receiving more molds. When the sand is dumped it is tempered and put through a vibratory riddle placed over a box on a skid. The filled box is carried back to the molding floor and set down in close proximity to the molder.

This process is illustrated in Figs. 6 and 7. Fig. 6 shows two molders working on one mold, the one making the cope and the other the drag. In front of each molder there is a pile of sand and between them there is a box of facing sand. Cores are used only in the drag of this mold. The rack on which the cores are brought from the core room may be seen to the right in front of the molder working on the drag. One line skids to the left has been filled the line to the right is nearly of molds. The line in the center been taken away to be dumped will be returned before the sec- line of skids is filled. In Fig. 7 the line of skids to the left has been poured and two workmen are lifting the flasks from the mold. This is done rapidly by means of two hooks which hang loosely on the bar carried by the two men. The hooks are let down and fall against both sides of the flask engaging the lugs. The workmen then raise the bar with a jerk and the flask comes from the

FIG. 8—CORES ARE SET ON A RACK BEHIND THE COREMAKER—FROM HERE THEY ARE SET INTO DOUBLE-END OVENS LOCATED ON THE OPPOSITE SIDE OF THE RACKS

mold. The flasks have been taken from the row of skids to the right and piled near the molder, and the electric truck is ready to lift the first skid and carry it to the dumping floor. This method of handling the sand has proved so beneficial in the short time it has been tried that the company contemplates adopting the system throughout the entire shop.

For a number of years a study has been made to determine the method of molding best suited to the demands of the shop, and it was finally decided that it would be advantageous to adopt the plain jar-ram molding machine for all machine work. The major advantage of this method which appealed to the company is the ease with which the machine may be changed from one patern to another. This is important to the Fort Pitt company because many of their customers

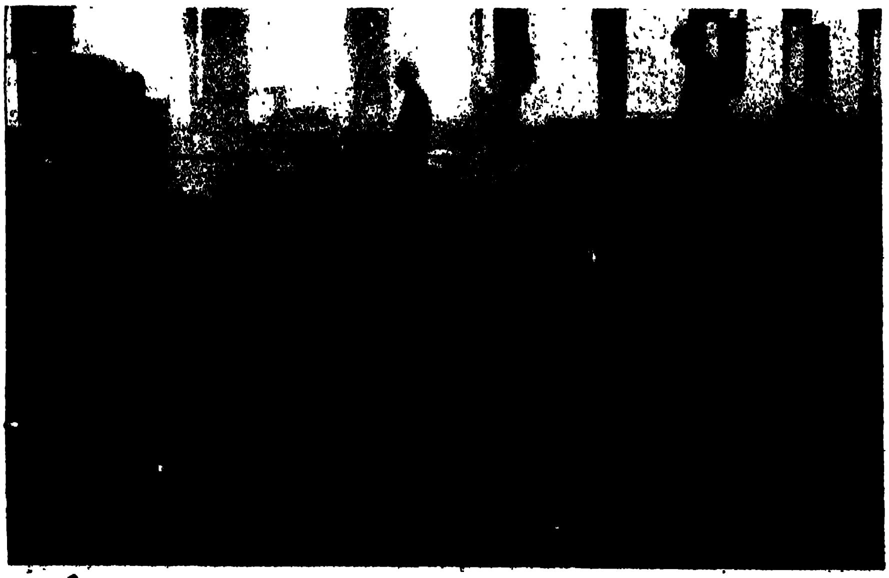


FIG. 7—WHILE THE MOLDERS ARE FILLING ONE ROW OF SKIDS, FLASKS ARE TAKEN FROM THE NEXT ROW AND THE OTHER ROW IS CARRIED TO THE DUMPING STATION

have short run orders which they send with their repetition work. Again, the company receives orders for a large number of castings which call for only a few a day. In such cases, with the jar-ram method it is no trouble to change from one pattern another. An illustration of a job being worked under these conditions that of a water scoop for a locomotive, Fig. 1. A large number of these castings are on order, but delivery of only four a day is required. For this reason, in order not to stock them, not more than four are made each day.

Jobs Easily Changed

In making these water scoops the pattern and flask are clamped to the machine and four drags are rammed. The lower portion of the core is made of dry sand, but the larger portion is made on the same machine as the mold. The core box is placed on the machine and jolted. Then the dry core is placed on top of the green sand section. This is covered with a form, as illustrated in Fig. 9. After the form and the core box are hooked together they are rolled over and the core box is lifted off. Then the core is raised by three hooks attached to a Y-shaped carrier as shown in Fig. 10, and lowered into position in the drag. The molds are finished by attaching the cope pattern and flask to the jarring machine and jarring four copes. Although the casting as shown in Fig. 1, has very thin walls to which are attached heavy lugs, no particular difficulty has been experienced in making them free from all shrinkage spots without use of chillers.

One of the most complicated and delicate castings which the company has to make is the wheel for an electric baggage truck with the blank gear cast inside. The casting with portions of the mold and cores is illustrated in Fig. 12. The mold is rammed on a jar-ram machine and a boy makes the body cores in the box shown to the front. This box is jarred and the end, sides and one top piece, shown at *A*, are removed. The core is lifted by a hook which screws into the arbor. Eight of these cores are required. Two of them may be seen in position in the drag. Two other cores are used to make the mold. The one is in sections and forms the upper portion of the rim of the wheel. This may be seen at *B*. The other dry-sand core is a center core forming the hub. The casting is poured from two horn gates cut in diagonally opposite corners of the mold. No brackets are used.

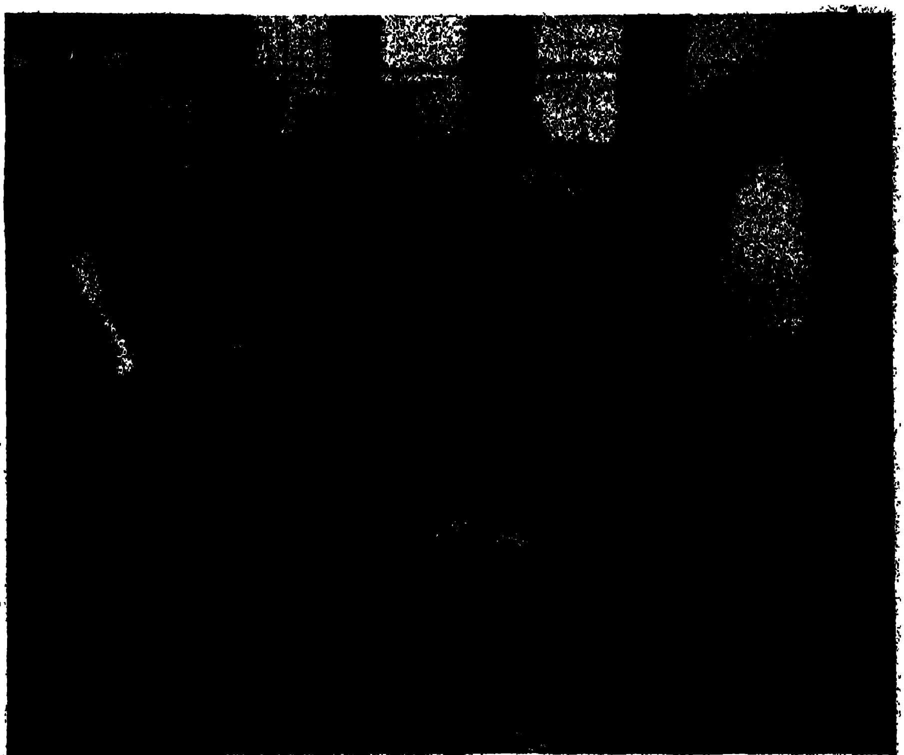


FIG. 10—THE DRY-SAND PART OF THE CORE SUPPORTS IT AS IT IS SET INTO THE MOLD

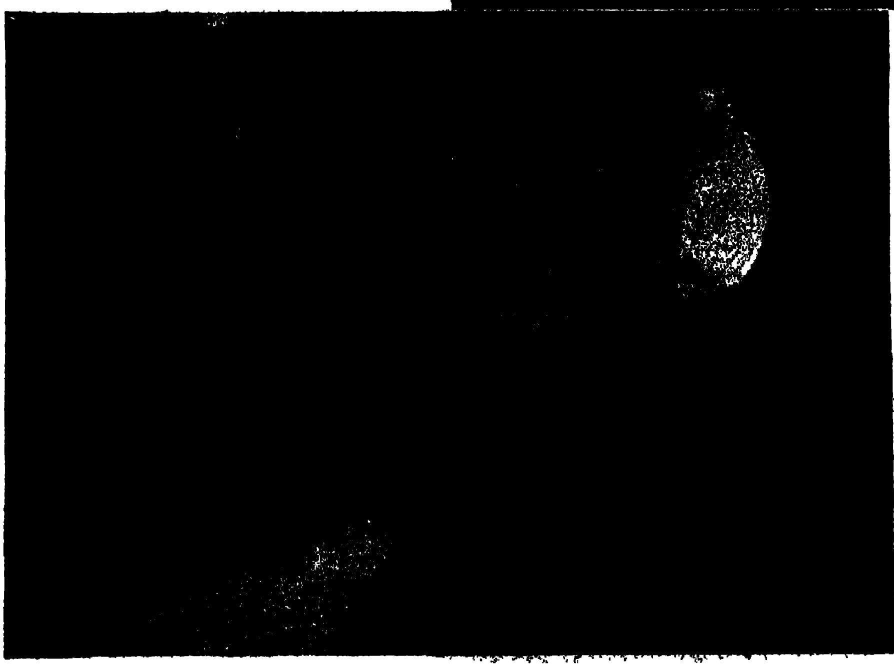


FIG. 9—A GREEN-SAND CORE IS JARRED ON A ... AND A DRY-SAND ... LAID ON TOP—AFTER A FORM IS PLACED OVER THE ... CORE, IT IS ...

One feature about the casting methods used by the Fort Pitt company is that few if any brackets are used. Even the driving cellar castings shown in Fig. 2 or the baggage truck wheel casting, just described have no brackets, although they are thin sectioned castings with sharp angles.

Company Trains Its Molders

The success of this company in handling difficult castings in a great measure is due to the high grade men employed. Practically all the molders employed, in fact all but two, have received their training in the company's own foundry.

It is possible for the company to train its own molders because the largest percentage of the molds are made on jar-ram machines of which 46 are installed, ranging in size from those with a 24 x 30-inch plate to the larger ones with a 3 x 4-foot plate. Practically no skill is required in ramming molds on this type machine, but considerable experience is necesary before the new operator becomes efficient in drawing the patterns. What little work is done by hand molding is segregated in two

FIG. 11—PASTE IS APPLIED TO THE CORE BY PRESSING THE CORE ON A PERFORATED FLOAT SUPPORTED IN THE PASTE

seperate portions of the shop. In the one the bench work is assigned and the other is devoted to floor work. However, a total of only 10 per cent of the molding area is given to hand molding. A committee decides where all molds should be gated and gate and riser sticks are supplied to the molder with the pattern so that nothing is left for him to determine.

Another feature about the molding practice is that all molds are made in green sand. The company has found that it can make its own flasks which will weigh little more than flasks made from rolled stock. These cast-steel flasks have ⅛-inch sides and are extremely long-lived, some of them having been in use for 15 years.

The core room is equipped with two jar-ram machines and seven roll-over machines. A row of roll-over machines is located along one wall of the core room. When the coremaker finishes a plate of cores he places the plate on a rack behind him. This may be seen in Fig. 8. The cores are put into four double-end ovens from these racks. As may be noted in Fig. 8, the ovens are directly in front of the racks. Drying stands on the opposite side of the ovens receive the cores as they are taken out. The cores are carried on the racks or on wood cradles to a bench where they are pasted. An ingenious scheme has been devised for pasting the cores. A liquid paste made of glutrin thickened with flour is mixed in a box. Then a wood float, as illustrated in Fig. 11, is laid on the liquid paste. This float has perforations and, when the core is pressed gently on the float, paste comes through the holes in the float and sticks to the core as may be noted. Each different style core has a special float. After the cores are pasted they again are placed in drying ovens for an hour.

13- TWO COREMAKERS WORK ON ONE JAR-RAM MACHINE—THE ONE JARS THE CORE AND THE OTHER FINISHES IT—TWO OR THREE BOXES ARE USED

Certain classes of cores are better adapted to the jar-ram mchine than to the roll-over machine and special arrangements have been made for the operation of these machines. Fig. 13 illustrates the method of operation on one of the jar-ram machines. The operator on the far side of the table fills the box with sand after placing any stiffening wires which are necessary. Then after jarring the box he pushes it across the table to the second operator who puts on a plate, turns the core box, and withdraws the box leaving the core on the plate. The plate is then set on a rack standing near. When the rack is full, it is placed in the drying oven with a lift truck. This oven may be seen to the left in Fig. 13, with a rack of cores

FIG. 12—THE GEAR WHEEL FOR AN ELECTRIC TRUCK IS MADE WITH GREEN-SAND BODY CORES

in front of it. Besides this rack oven there are four other similar ovens, the four ovens previously mentioned, and one cabinet revolving table oven in the core department. These ovens are all arranged to burn either oil, s or coke. The flexibility of the method for making cores is shown this illustration where the core-er has just passed a shallow box oss the table and is starting to a deep box. With this machine different cores could be made every time, but the usual custom is to run two or three different boxes in turn until the required number of cores are made from any one box when a different box is substituted.

The core room, as may be noted in Fig. 4, is located at one end of one of the molding bays. Cores are taken from here to the molding floors on racks either by electric or by hand-lift trucks. This is easily done as a system of concrete aisles have been laid all through the buildings. The proximity of the molding floors to the finishing department affords ready access to the grinders of which there are 12 of the swinging type and 8 double stands. All of these are direct connected to individual motors. The finishing room also contains a full complement of sandblast equipment. There are two revolving table rooms 8 x 8 x 8 feet together with one cabinet of the revolving type and two 40 x 50 sandblast tumbling barrels. One of the latter is rigged so that it will automatically drop its load of castings into a truck placed beneath it.

Provision is made for welding castings when necessary either by electric or oxyacetylene welders. The electric welder is employed where there is much metal to be built up and the gas welder is used for deep thin holes.

FIG. 15—TWO CARS ARE USED WITH THE ANNEALING OVEN—WHILE ONE CAR IS IN THE OVEN, CASTINGS ARE UNLOADED AND LOADED ON THE OTHER CAR

The castings to be welded are placed on one side of a table which revolves on roller bearings and has a sheet iron shield across the center of it. The table is then turned 180 degrees and the shield protects the workman who is placing the castings on the table while the welder is working on the other side. Welded castings are always annealed after welding.

The greater percentage of castings are annealed in a car type furnace shown in Fig. 15. This furnace is coal-fired through two doors on the side opposite to the one shown in the illustration. Four thermo-couples are used to determine the temperature of the oven. Two of them are placed near each end at the top and two extend through the side opposite the firing doors. These are attached to a recording instrument. A selective switch also connects any one to an indicating instrument. Castings are piled carefully on one of the two cars. When it is desired to place the castings in the oven the doors are opened and the two cars are moved, the one out of the oven and the other into the oven by a continuous wire rope operated by an electric winch. The furnace holds approximately 4½ tons and the castings are heated 5 hours on the average. After that they are left to cool in the oven from 8 to 12 hours.

In addition to the car-type oven two muffle ovens are employed. These ovens were used for all annealing, but since the car-type oven has been installed, they are used only for annealing the most intricate castings which require special care in packing. The main advantage in the car-type oven is that it is easier to load and unload, and that it can be operated almost continually.

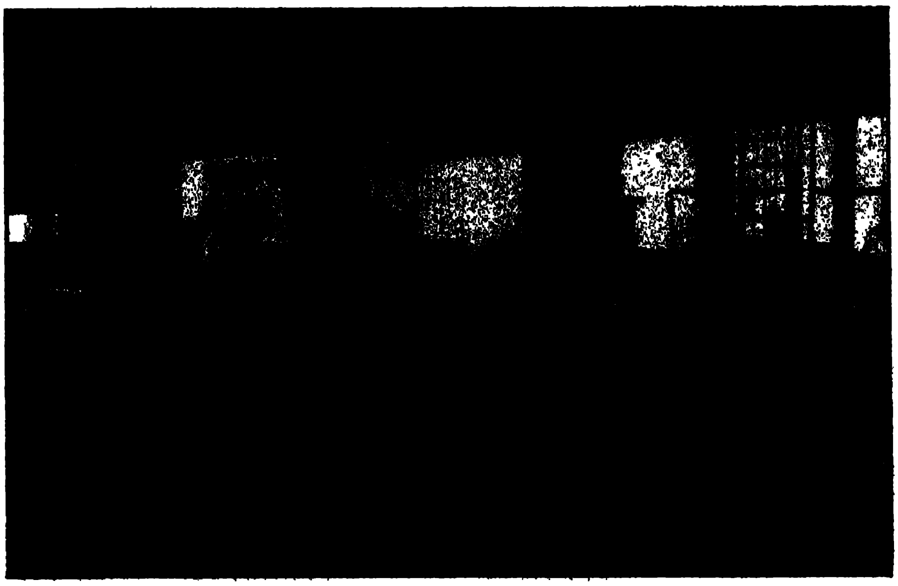


FIG. 14—CASTINGS ARE BROUGHT TO THE GRINDERS ON SKIDS BY AN ELECTRIC LIFT TRUCK—SOME SKIDS HAVE WOOD RUNNERS WHILE OTHERS HAVE RUNNERS MADE OF CAST STEEL

One of the difficulties which so frequently exists in the cleaning departments of steel foundries is to handle the work systematically and in the order in which it was produced in the casting department. The Fort Pitt company has to a great extent overcome this difficulty by an arrangement of skids, handled by electric lift trucks. Reference to Fig. 14 will show the general use of these skids as applied to the grinding department. A skid full of castings to be ground is placed behind a grinding machine, and an empty skid is stood aside of it. The workman takes the casting from one skid, and after it is ground, places it on the other. The same system is applied in every other operation in the finishing department. By this method, no castings are placed on the floor at any stage of the operation.

Resume Operations in Indiana Foundry

Operation of the Huntington Steel Foundry Co., Huntington, Ind., will be resumed immediately by a new and refinanced company which has acquired the property. William H. Armstrong, mayor of Racine, Wis., who is president of the reorganized company, has had a wide manufacturing experience. For seven years he was secretary and treasurer of the Mitchell Motors Co., and now is president of the Armstrong Foundry Co.; president of the Splitex Radiator Co., and vice president of the American National bank, all of Racine. E. T. Pelton of Chicago, the new vice president of the Huntington Steel Foundry Co., has had over 20 years in steel casting manufacture. He was associated with the National Steel Foundries, Milwaukee, for a number of years, and was then general manager of the Pelton Steel Co., that city, which company still bears his name. Recently, however, he has been identified as consulting engineer with Frank D. Chase, Inc., Chicago. N. I. Silver, Racine, is secretary and Leo Cohen, Chicago, is treasurer. The new company will specialize on electric steel castings, operating a jobbing plant and will discontinue the production of gray iron castings.

Withdraws from Castings Company

The American Metallurgical Corp., Philadelphia, announces that its holdings in the Philadelphia Electric Steel Castings Co., Philadelphia, have been sold to the recent purchaser of that company, and the Metallurgical corporation has withdrawn from the company, both in connection with the finance and as to service of its officials.

West Point Foundry Elects Officers

At a recent meeting of the stockholders of the West Point Foundry Co., West Point, Montgomery county, Pa., the following officers were elected: President and secretary, Herbert L. James, vice president, Llewellyn M. James; treasurer and manager, Samuel B. Strauss. These men have had many years of practical shop and foundry experience. Herbert L. James was connected with the Crane Iron Works, Catasauqua, Pa., for fourteen years manufacturing gray iron basic and low phosphorus pig iron. For the past 15 years he has been managing machine shops and foundries making light and heavy castings in green sand, dry sand and loam. Llewellyn M. James also has had an extensive experience in the same line. During the war he served as superintendent of production on marine engines for the United States shipping board. Samuel B. Strauss has had 20 years' experience as molder and superintendent of foundries in the vicinity of Norristown, Pa.

The main foundry building measures 40 x 150 feet, or 6000 square feet of molding space. The cupola capacity is 30 tons a day. The cleaning room and core ovens are almost finished and it is expected that production will commerce shortly. The company claims to have contracts and work in sight for the next three years.

Forehearths Not Often Installed

By H. E. Diller

Question: We should like to know if many foundries use forehearths on their cupolas and what are the advantages of such hearths.

Answer: Few foundries in this country use forehearths with their cupolas, but it was almost the universal custom in Europe to use them. In more recent years many of the new installations in Europe do not include them. The advantages claimed for forehearths are the retention of heat in the metal longer than if the metal is held in the cupola or in a mixing ladle. It also is claimed that less sulphur is taken up by the iron when the forehearth is used. The forehearth is simply a covered vessel for holding the iron with a hole for tapping the metal and another for tapping the slag. It is directly connected to the cupola so that the metal may run into it as soon as it is melted. When the metal is in the forehearth it is not subjected to the action of the cold air from the blast which would strike it were the metal held in the cupola; neither does it lay against the coke bed, and so it may absorb less sulphur. Just how much advantage is gained in these respects has never been measured. On the other hand, the expense of keeping up the lining of the forehearth is a detriment, and it is not as flexible as a ladle which may be removed easily when desired.

Establish Alloy Foundry

An aluminum and brass foundry has just been established at 2157 Blue Island avenue, Chicago, under the name the National Aluminum & Brass Foundry, by Victor S. Kucki and Frank T. Luka. Jobbing work in nonferrous alloys will be produced.

Water Causes Explosion

In a recent accident the top of a steel furnace was blown off when a charging box of scrap, containing some water, was dumped into the furnace. This charging box was loaded out of doors and a considerable amount snow had collected on the scrap. W[illegible] brought in doors the snow melted the water collected in the bottom [illegible] the box. It is of course evident th[illegible] had drain holes be[illegible]provided in bottom of this box[illegible] would hav held no water and the explosion would not have occurred.

Selling Agency Secured

The B. & B. Mfg. Co., Indianapolis, manufacturer of molding machines has entered into an arrangement with the American Molding Machine Co., whereby the latter company attends to the selling end of the business. The two companies continue as before entirely independent entities each operating its own manufacturing plant; but with the American Molding Machine Co., attending to all the sales.

All Ready for Columbus Convention

(*Concluded from page* 716)

Co. also has a foundry in Columbus.

An interesting and rather unusual foundry is that operated by M. C. Lilley & Co., which manufactures lodge and society regalia. This firm produces its own small nonferrous castings which enter into the ornamentation of its uniforms. In addition to this foundry, several brass shops supplying machinery castings and plumbers goods are in operation. These include the Atlas Brass Foundry, the Columbus Brass Co., the Buckeye Pump & Mfg. Co., the Ohio Pump & Brass Co. and the Hocking Valley Railway Co. foundry. The Seagrave Co., builder of fire apparatus, has a brass foundry of its own.

Ohio State university maintains an interesting shop where its engineering students are instructed in elementary foundry practice in connection with their course in shop practice. Patternmaking, similarly is taught in the woodworking shops of the university.

The name of the Detroit Valve & Fittings and Detroit Brass Works, Detroit, Mich., has been changed to the Detroit Brass & Malleable Works. This represents a consolidation of two well-known interests which retained a combined name until the present time.

English Foundry Makes Rail Chairs

Quantity Production Methods Are Employed in This British Shop—Molds Are Made on Roll-Over, Stripping-Plate Machines of Special Design — Cupolas Melt Continuously

BY H. COLE ESTEP

AIL chairs are virtually unknown in the United States. In Great Britain, however, they are required in such large quantities that a number of gray-iron foundries have been designed and built to deal almost exclusively with this specialized commodity. These shops are equipped with all of the facilities usually found in modern manufacturing foundries. Molding machines, mechanical sand-handling apparatus, mold conveyers, pouring devices, etc., are extensively employed. The rail chairs and kindred products are turned out on a quantity basis under conditions calculated to produce the greatest tonnage at the lowest possible cost. The equipment used and problems encountered, therefore, possess many features worthy of study by American and other foundrymen interested in mass production, even though they may not make exactly the same sort of castings. Among the several producers of rail chairs in the United Kingdom, one of the most prominent and largest is Smith-Patterson & Co., Ltd., Blaydon-on-Tyne, near Newcastle, England. Under the direction of R. O. Patterson, works manager, this company recently has placed in operation a new rail-chair foundry embodying a number of unusual and interesting features which it is the purpose of this article to describe. But before taking up the details of the new Smith-Patterson foundry, it is perhaps advisable to present a few facts regarding the rail-chair industry in Great Britain as a whole inasmuch as it has no counterpart in the United States.

FIG. 1—THE "CHAIRED METALS" OF KIPLING—SECTION OF A BRITISH RAILWAY LINE SHOWING HOW RAIL CHAIRS ARE USED

The rail-chair business has grown up as a result of a fundamental difference in the construction of railroad

The author, H Cole Estep, is European manager, THE FOUNDRY.

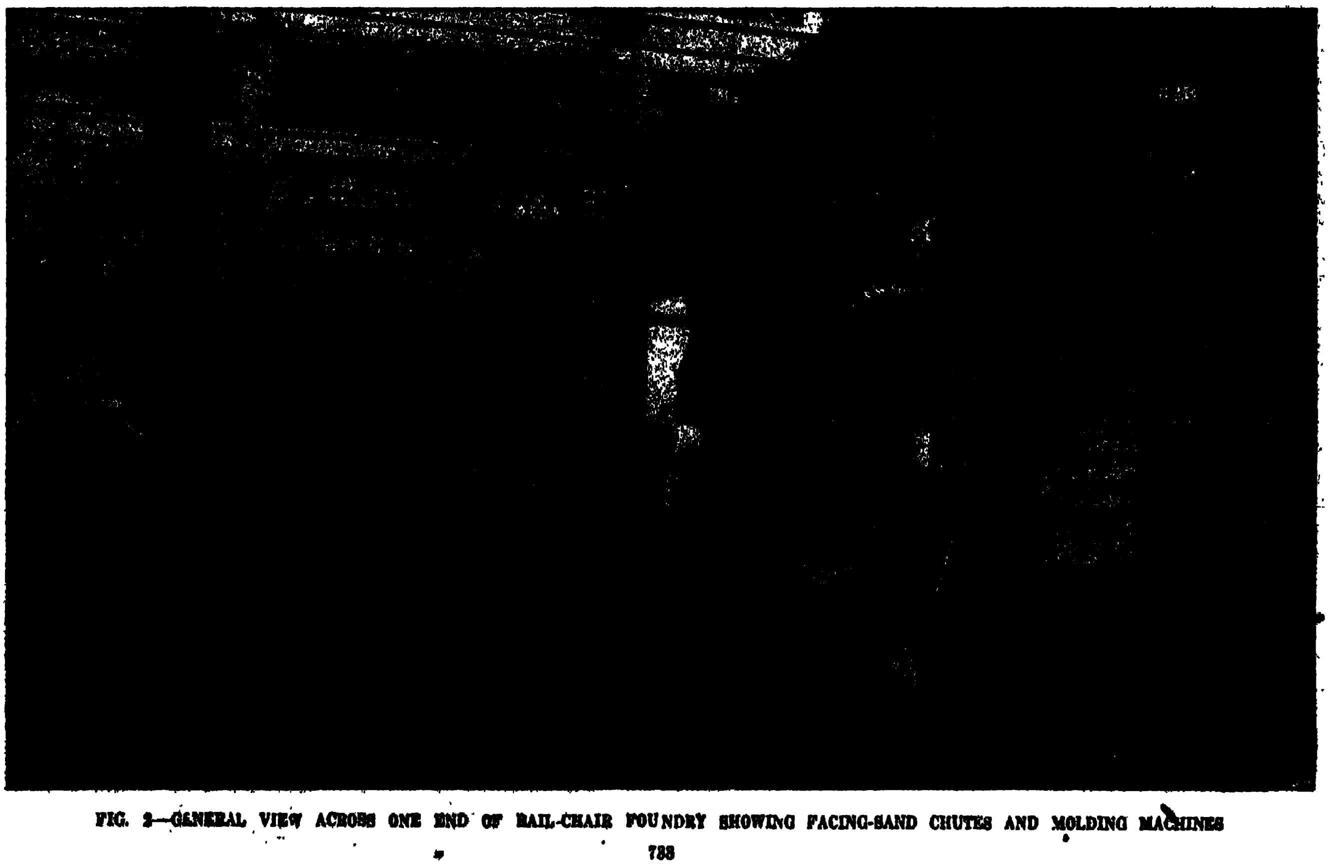


FIG. 2—GENERAL VIEW ACROSS ONE END OF RAIL-CHAIR FOUNDRY SHOWING FACING-SAND CHUTES AND MOLDING MACHINES

FIG. 3—ONE OF THE GANGWAYS SHOWING TRAIN OF MOLDS READY FOR POURING, WITH SAND CHUTE AND MOLDERS' STATION IN BACKGROUND

tracks in the United States and the British Isles. American railroads use flat-bottom rails which are spiked directly to the ties, or sleepers, as they are called abroad. British and most European railroads use bull-headed or double-headed rails which rest on specially designed cast-iron chairs that are in turn spiked to the ties. The bottom of the rail is raised about 1½ inches above the tie. A section of a British railway line showing how the rail chairs are used is shown in Fig. 1. A plan and elevation of a 50-pound chair showing the rail and wooden wedge in place are presented in Fig. 7. This form of track construction of course is considerably more expensive than that employed in the United States, but it is said to have the threefold advantage of holding the track securely to gage, protecting the ties from wear, and making it possible to use a less number of ties. On most English railways the ties are spaced on 31-inch centers. Some idea of the size and importance of the British rail-chair industry may be gathered from the fact that since, according to the latest figures, there are 55,261 miles of track in Great Britain, there must be about 226,000,000 rail chairs in use. They have a limited life, about 20 years, and, therefore, the replacement demand alone is heavy and continuous.

The chairs are made of a good grade of gray iron. They are of various weights to fit the different weights of rail. Most of those now being made weigh about 50 pounds each. They are about 1 foot 3 inches long and 7½ inches wide on the base, which is 1⅛ inches thick. They usually are provided with four spike holes which taper from 1¼ inches in diameter at the top to 1 5/32 inches at the bottom. As will be described in detail later, these holes are made with green-sand cores. As shown in Fig. 7, the lip against which the rail sets has a back draft, which makes it necessary to provide the pattern with a loose piece. Another loose piece is necessary to form the horn lip which holds the wooden wedge in place. The molds are made on roll-over pattern-drawing machines, and as Fig. 3 and subsequent illustrations indicate, the job is not quite so simple as first appearances might indicate. The castings must have a good finish, be sound and strong, and meet certain tests prescribed by the railway companies.

Smith-Patterson & Co. also m brake shoes in their rail-chair fou ry. The brake-shoe castings wei from 21 to 56 poi each and molded three in a ik. using t same general equipment and method as that employed for rail chairs. Of course in the case of brake shoes, provision must be made for setting the dry-sand cores. In addition to the foregoing, special rail-chairs are made for switches and turnouts, together with car journal-boxes, buffers, permanent way, and miscellaneous railway castings. In their jobbing foundries, Smith-Patterson & Co. also make turbine casings and a large number of other gray-iron castings of various sorts. The firm employs 400 men and has a capacity of about 750 tons of castings a week. The business was established in 1865. The plant was moved to its present location in 1872; about 10 acres of ground are occupied at present. But it is mainly with rail-chair production that this article is concerned.

The new rail-chair foundry employs about 50 men. It is housed in a specially designed building, 117 feet long and 102 feet wide. A general plan and elevation of this structure is shown

FIG. 4—ONE OF THE MOLDING MACHINES WITH FLASK ROLLED OVER READY TO DRAW PATTERN

in Fig. 9. As this illustration indicates, the molding room, which is surmounted by a saw-tooth roof, is divided into six longitudinal bays each 17 feet wide and 92 feet long. A cross bay 25 feet wide adjoins one ... of the molding floor and covers ends of the longitudinal bays. This ...s-bay is provided with a 3-ton ...eling crane which runs out into the ...d to facilitate the delivery of fin...d castings. The building is a ...l-frame structure, the eaves being ... feet from the ground over the molding floor. The eaves over the cross bay at the end of the shop are 29½ feet from the ground. A cement tile roof is provided, and the saw-tooth construction gives ample light, without shadows, throughout the foundry.

Charging Floor in the Open

The cupola furnaces, two in number, are placed at one end of the molding room, just outside the building, as shown in Fig. 9. According to the English custom, and owing to the mild climate, the cupolas and charging floor are practically in the open air A leanto at one side of the main building houses the small-core room and sand-mixing room. The former is equipped with three core ovens for baking the small brake-shoe cores.

Each of the 17-foot bays in the molding room is served by an overhead trolley rail, which connects with a cross trolley extending the full width of the shop in front of the cupolas. The layout of the trolley tracks is clearly shown in Fig. 9. This arrangement is used for distributing the hot metal to the various floors.

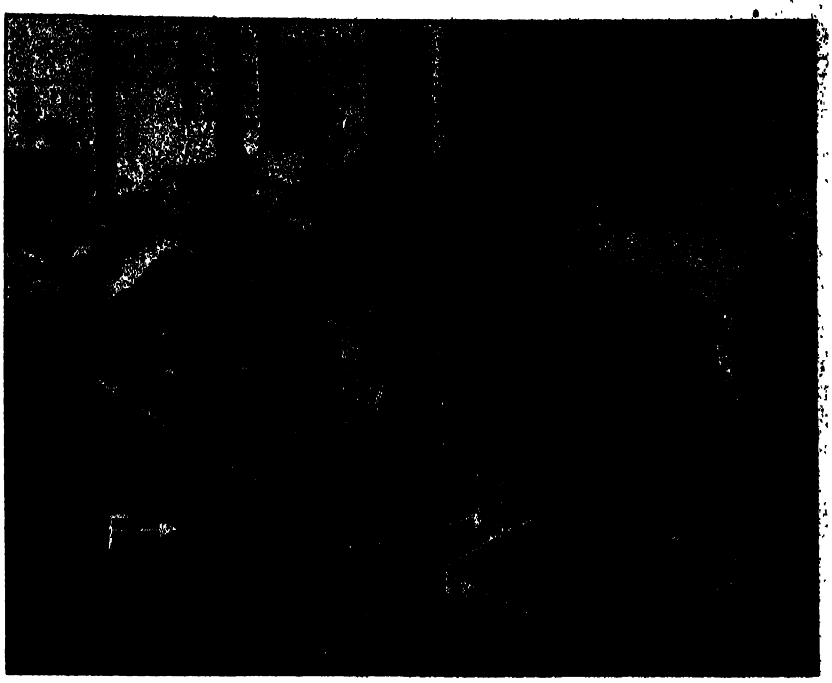


FIG 6—AFTER THE DRAGS ARE MADE THE MOLDS ARE ADVANCED TO THE COPE STATION WHERE THE FINAL OPERATIONS BEFORE POURING ARE PERFORMED

The plant is operated on the continuous melting system. In general, the method of operation is similar to that of American foundries of the continuous type. The work of preparing the sand, molding, melting, pouring, shaking out and cleaning is performed by separate gangs of men who confine themselves strictly to their own tasks. The molders work continuously throughout the day, and the operations of casting, shaking out, cleaning, etc., proceed simultaneously.

To accomplish this, each of the six bays into which the foundry is divided is operated as a unit. The rail chairs and brake shoes are molded in simple two-part flasks each containing three castings. The drags are molded on the machines previously mentioned, each of the six bays being equipped with a machine. For the copes, simple ramming stands are located near the molding machines, at the end of each floor nearest the cupolas. Each molding floor is supplied with facing sand by a hopper filled from overhead. Hot sand returned from the shake-out floors is used for back filling the molds. In addition, a small quantity of specially milled sand is provided for ramming around the rail seats and gullets, at the points marked *B* in Fig. 7.

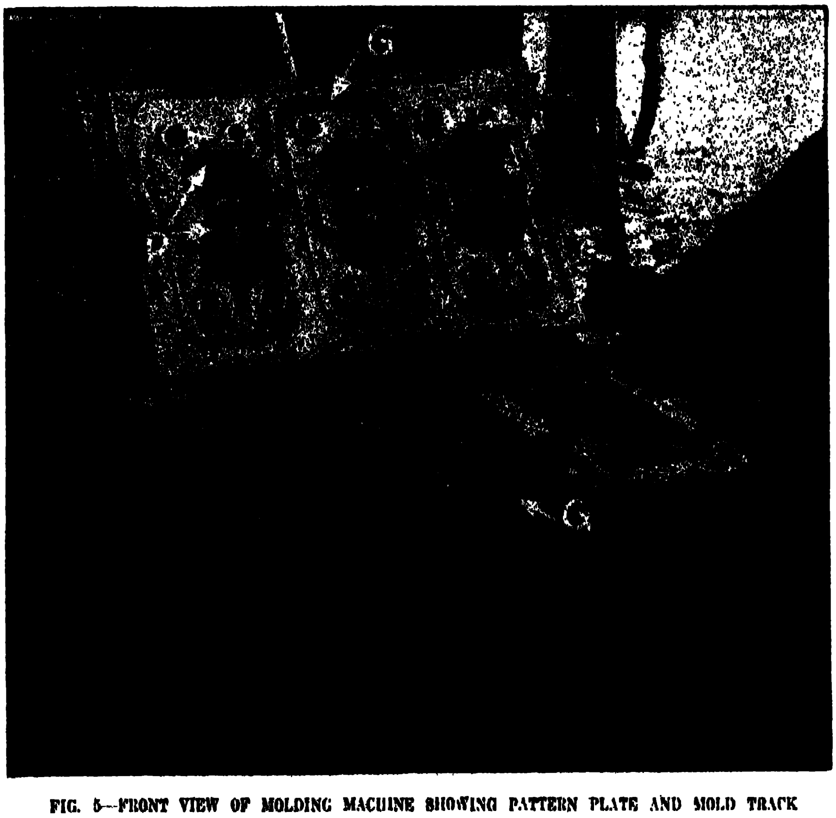


FIG. 5—FRONT VIEW OF MOLDING MACHINE SHOWING PATTERN PLATE AND MOLD TRACK

Mechanical Handling Methods

It is inconsistent with the conditions of continuous operation to set the molds out on the floor and pour them all at the end of the day in the ordinary manner. Some mechanical method of handling them must be provided to keep the molding, pouring and shake-out gangs constantly employed, thus securing a maximum of tonnage from a minimum of floor space and men. This principle —the mechanical handling of the molds —forms the heart of any continuous foundry system. At the Smith-Patterson foundry, unique means, embodying interesting features, are employed for performing this essential part in operating a shop under the continuous system.

As the molds are made one by one they are placed on small low four-wheel platform trucks. The drag-molds are rolled over directly onto these trucks by the molding machines. These machines are located, as previously mentioned, at the extreme end of the molding bay, alongside the facing-sand chutes, as shown in Figs. 2 and 9. The mold-trucks travel straight down the floor to the other end of the bay, passing the cope and pouring stations enroute, and terminating at the shake-out station which is located in the cross-bay under the traveling crane. The mold-trucks usually are handled in groups of eight, this being the number cast from a single ladleful of iron. The trucks do This operation is shown more in detail in Fig. 6. Further in the background of Fig. 3, at *C*, may be seen the facing sand chute and drag molding machine. Back of the sand chute, the outlines of one of the cupolas is visible. A detail view of the drag-molding station, from which the mold trucks start on their journey, is presented in Fig. 11. Fig. 2 is a view across the shop showing the six molding stations and facing-sand hoppers in their respective parallel bays.

As previously suggested each unit is operated on the straight-line principle. After the molds are poured, as shown in Fig. 3, the copes are removed, while the castings are still red hot, and returned by hand to the cope-ramming sand and storage facilities must be provided so the spent sand has time, to cool and season before it is used again. If the sand arrives at the molder's station warm and "green," trouble usually ensues, and for this reason efforts to save cost in sand-handling syste through cutting down storage space reducing the volume of sand to be with generally have proved abo Some of the most successful Ameri systems are those which have designed that the same sand is used more than once a day. This necessary because in practically all continuous foundries in the United States, for the sake of simplicity, only one kind of sand is used throughout the plant.

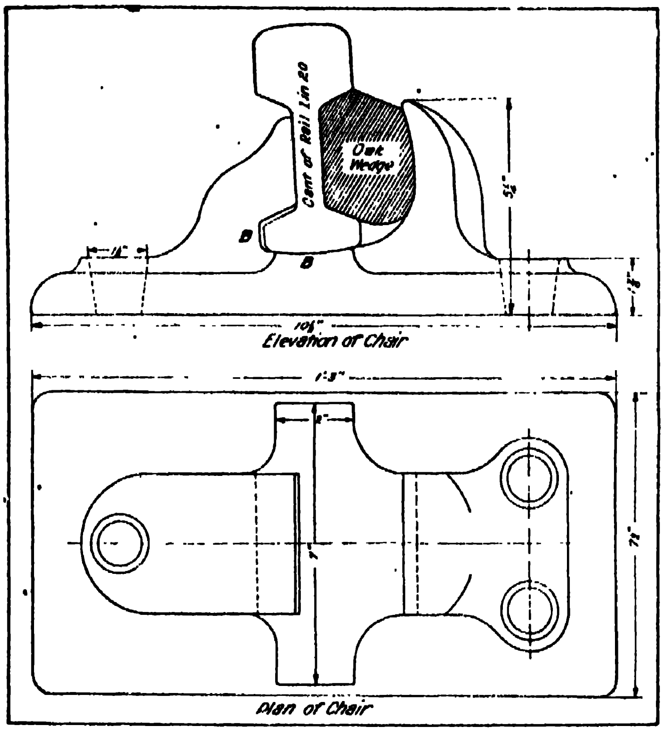


FIG. 7—PLAN AND ELEVATION OF A TYPICAL ENGLISH CHAIR RAIL FIG. 8—THE DELIVERY CRANE RUNS OUT INTO THE YARD FOR CONVENIENCE IN HANDLING AND SHIPPING CASTINGS

not run on tracks but on the floor, each bay being provided with a paved gangway. The trucks are light and are hauled around entirely by hand. To guide the trains in a straight line, one side of each gangway is guarded by a guard rail set on edge in the floor as shown at *F* in Figs. 3 and 6. This acts as a flange or rail against which the mold-trucks are lined-up for pouring. The hot metal is brought to each floor at appropriate intervals in trolley ladles running on the monorail system.

The entire operation is shown clearly in Fig. 3, in which a train of molds may be seen ready for casting, the pouring ladle being in position in front of the first truck. In the middle distance, to the right of the man sitting on the sand heap, is the station where the copes are rammed and set in position on the drags as the trucks go past. station where the sand is shaken out. The mold-trucks then are hauled onto the end of the floor where the castings are removed for cleaning under the traveling crane. After the castings are shaken out, the trucks, with the drag flasks and spent sand, are hauled back to the molding machine. Here the sand is shaken out of the drags, and the trucks and flasks are then ready to start out on a new journey to the delivery end of the floor.

How the Sand is Prepared

From some standpoints, the sand-handling problem is one of the most difficult to solve in continuous foundry operation. If the whole body of sand is handled and constantly retreated, not only must apparatus be provided for dealing with a large tonnage per hour, but experience has demonstrated that sufficient The whole body of sand is treated and tempered as a unit; it may be said, therefore, that all of it is of facing-sand quality. The sand in each flask is uniform throughout.

At the Smith-Patterson rail-chair foundry, a successful compromise solution has been arrived at by using three kinds of sand, as previously mentioned. The cost of the sand-handling plant is thus greatly reduced, since provision has to be made for handling and treating mechanically only a small proportion of the total volume of sand used every day. In fact the sand-handling plant deals only with the facing sand. In addition, a small quantity of sand is given a double milling, and used to form the rail seats and gullets of the chairs, as has been described. For back-filling, that is for 90 per cent of the sand in each flask, black hot sand is used

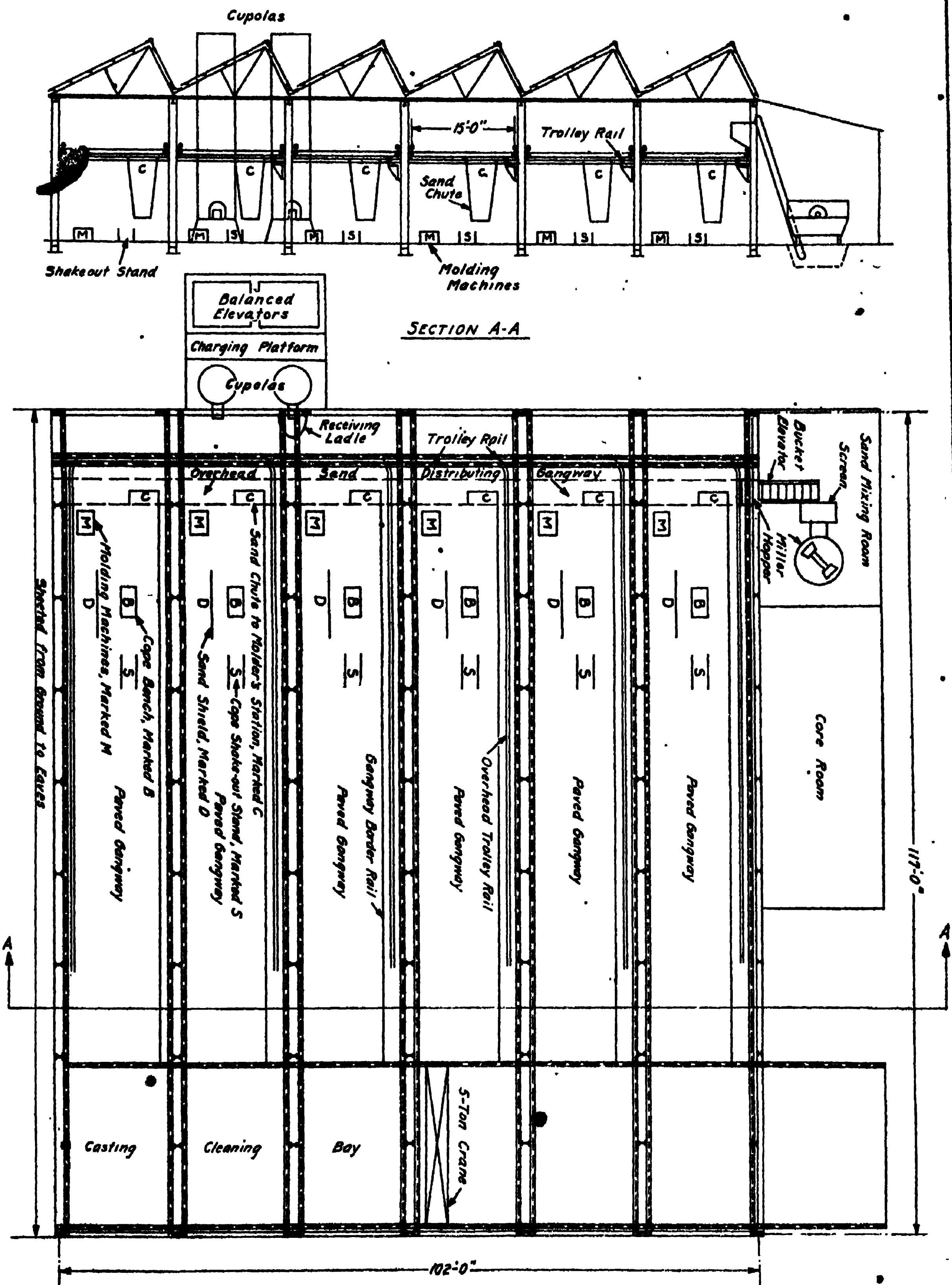


FIG. [illegible] OF NEW RAIL-CHAIR AND BRAKE-SHOE FOUNDRY, NEAR NEWCASTLE, ENGLAND—NOTE ARRANGEMENT OF FLOORS, MONORAIL AND SAND-HANDLING APPARATUS

over and over again with perfectly satisfactory results to the Smith-Patterson organization.

The sand preparing plant is shown in Fig. 10. It consists simply of a pan muller of the usual type in which the sand is milled, a mechanically operated oscillating shaker, and a bucket elevator in which the prepared facing is hoisted to the distributing gallery which runs across the shop as shown in Fig. 2. The sand is shoveled from the muller into the sifter, from which it drops by gravity into the boot of the bucket elevator. At one end of the distributing gallery is a hopper into which the bucket elevator discharges. From this hopper, the sand is let out by an attendant into a light buggy which is utilized to keep the molders' hoppers filled. The latter extend from the distributing gallery to the floor, and are about 12 feet in height with a 24-inch cross-section at the bottom and a 24 x 38-inch section at the top. These hoppers are made of wood, with cast-iron bottoms set on cast legs. Each molding bay is provided with a facing-sand hopper as previously explained, and as shown in Figs. 2 and 9. The small quantities of extra-milled sand used for facing the rail-seats and gullets are handled in barrows.

The ordinary facing sand consists of a mixture of about 10 per cent new sand and 90 per cent old sand, with appropriate quantities of ground sea coal. Neither clay nor sharp sand need be added, since the new sand used has the proper characteristics and binding qualities. It comes from the Thames river, near London, and is known as "Erith Loam." This is one of the most celebrated foundry sands in Europe. For the extra-milled rail-seat facing about a quarter of new sand is employed.

The machines on which the drags are molded are of a special design invented and developed by the executives of Smith-Patterson & Co. They are of the roll-over, stripping-plate type. Metal patterns, which are very carefully and accurately made, are employed. The molds are rammed by hand and rolled-over in the same manner. But for the roll-over operation a balance-weight is provided. The general arrangement of the molding machine is shown in Figs. 4 and 5; the latter also shows the construction of the mold-truck clearly. It consists simply of a steel plate platform mounted on four 6-inch wheels which are held onto fixed axles by cotter pins. Twenty sets of flasks and trucks are provided for each floor.

Fig. 4 shows the flask rolled over, with the machine in position just prior to drawing the pattern. The stripping plate is manipulated by a simple lever and toggle arrangement. The green-sand cores which form the spike holes are held in place by stopper rods while the pattern is being stripped out of the sand. The method of bolting the stoppers to flat steel yoke-straps on the back of the roll-over plate is clearly shown in Fig. 4. This illustration also shows the chains connecting with the counterweight.

The drag flasks are made of heavy cast iron. They are tapered to save sand, and are 2 feet 5 inches long by 19½ inches wide on top and 2 feet 3 inches by 12 inches on the bottom, the platforms of the carrying trucks, which serve as bottom boards, being 2 feet 5 inches by 14 inches. The molds are poured through one runner leading to two gates, each of which feeds the center casting and one of the end castings. The gating is clearly shown the pattern-board and in the mol Fig. 5. The spike holes in the pat which form the green-sand cores ously mentioned, are brass bushed avoid corrosion. In fact the pa are thoroughly fin d in every ticular. In Fig. 5, the ate is shown *G* and the loose pieces on the pattern at *P*.

After fitting the flask to the roll-over board, there are 12 operations in molding the drag, as follows:

1.—Spread milled sand on rail-seat and gullet by hand and tuck.
2.—Shovel one shovelful of facing sand.
3.—Fill flask with black (hot) sand.
4.—Ram around pattern and continue to fill flask with black sand.
5.—Cross ram.
6.—Butt ram.
7.—Strike-off with handle of rammer.
8.—Vent mold with venting wire.
9.—Roll-over flask.
10.—Draw pattern.
11.—Draw loose pieces and replace them on pattern.
12.—Haul truck with completed drag mold away.

The flask-pins, as shown in Fig. 4, are square, fitting into square notches in the drag. The cope is clamped by a narrow wedge which is driven through a rectangular hole in the flask pin. The drag is clamped in the same manner

FIG. 10—GENERAL VIEW OF SAND MIXING DEPARTMENT

FIG. 11—ONE OF THE DRAG MOLDING STATIONS SHOWING MOLDING MACHINE AND SAND HOPPER

for rolling-over on the machine. The copes, which are also cast iron, are 19½ x 29 inches in dimensions and 3½ inches deep. Each cope is divided into 12 sand compartments by five cross bars and one longitudinal bar. The copes are rammed by hand on specially structed stands which are located r the molding machines. These nds are provided with smooth cast-n tops equipped with notches to re-e the flask s. A conical nosed mmer, shown Fig. 6, is employed. his illustration shows the general arrangement of the cope-ramming station, including the steel plates which are set on edge in the floor to keep the heap of sand in place. At the left in this illustration is shown the arrangement for shaking-out the copes. Ordinary black sand is used in the copes, which are merely flat cover plates.

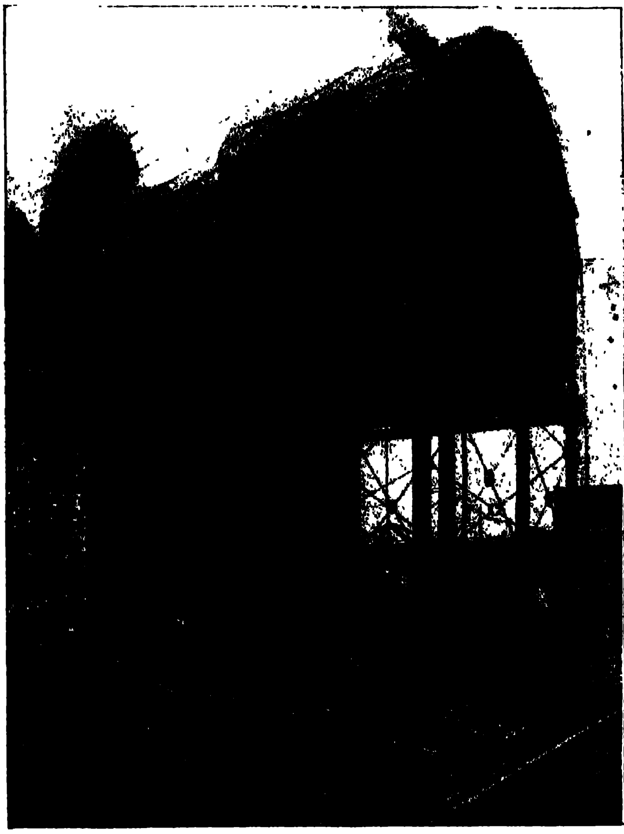


FIG. 12 A BALANCED ELEVATOR SERVES THE CHARGING PLATFORM

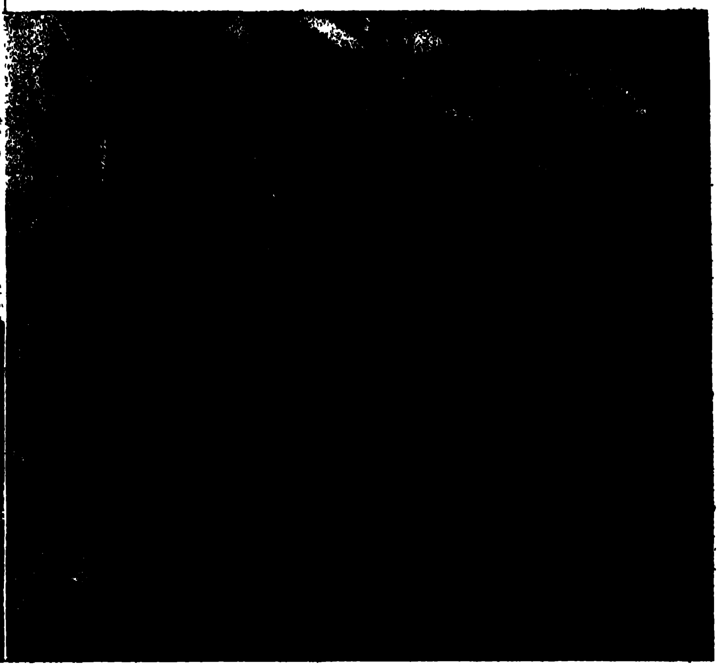


FIG. 13—THE CUPOLAS ARE OPERATED CONTINUOUSLY ON ALTERNATE DAYS

Six Men in a Gang

For handling the work, each unit is provided with two men for operating the molding machine, two boys for making the copes and closing the molds; one man for hauling the mold-trucks, called the bogey puller; and one man for unloading and wheeling out the finished castings. The bogey puller and his companion uncover the molds and shake-out the copes. Each molding gang, therefore, consists of six persons.

An average day's work for each unit is 20 casts of eight molds each, or 160 molds containing 480 castings, with an aggregate weight including the gates and sprues, of about 26,400 pounds or nearly 12 tons. The castings each weigh about 50 pounds and the gates, etc., about 5 pounds. Under favorable circumstances a single unit has turned out 26 casts in a day, this being equivalent to 208 molds, or 624 castings with a *net* weight of 31,200 pounds. The men are paid on a piecework basis.

A pouring gang is provided for each two molding units. Three such gangs, therefore, handle all of the metal that is required. Each pouring gang consists of a caster, or ladle man, and a skimming boy. They also are paid on a piece-rate basis. The cupolas have been in use for some time but were recently reconditioned and fitted with drop-bottom doors. These cupolas are 54 inches in diameter inside of lining and have a melting capacity of about 10 tons per hour. The rail-chair foundry melts approximately 80 tons a day—British long tons. The general arrangement of the cupolas, together with the charging floor and balanced elevator hoist, are shown in Figs. 12 and 13. The cupolas are operated on alternate days, and when working supply metal to the floors continuously. The first metal is tapped at 7:30 a. m., and from that time until 4:45 p. m., the wind is not taken off, except during the lunch hour. The tap hole is always open.

To handle the metal, a cap-shaped receiving ladle is employed. It is shown in Fig. 13, and has a capacity of about 3360 pounds. It was designed and built by the Smith-Patterson company, and is made of cast iron lined with loam instead of fireclay or bricks. The ladle is suspended from a trolley as shown in Fig. 13, and may therefore be used to serve either cupola. It has the usual hand-wheel and spur-gear tilting mechanism. The pouring ladles, which are hand tilted, have a capacity of about 1680 pounds, and are also lined with loam.

A Ten to One Ratio

Although the melting ratio, exclusive of the bed charge, is 10 to 1, the metal comes down very hot, and frequently it is found advisable to put a half a dozen sprues in the bottom of the pouring ladle. This also forms a convenient method of remelting the sprues.

Each cupola is equipped with one row of tuyeres made as nearly continuous as possible. The lower lips of the tuyeres are 2 feet 5 inches above the bottom, and a 9-inch sand bottom is employed. The charging door is 12 feet 9 inches from the bottom of the cupola. This is believed to be too low. Two more cupolas are going to be installed and after they arrive the charging platform will be raised 3 feet.

A fan blower furnishes the blast for the cupola at an average pressure of 20 to 21 inches of water. The fan is driven by a 28-horsepower electric motor.

Owing to existing conditions, the melting mixtures vary. The melt usually contains from 30 to 50 per cent scrap, the balance being made up with No. 4 Cleveland pig iron which has the following analysis: Silicon, 2 to 2.50 per cent; manganese, 0.45 per cent; phos-

phorus, 1.5 per cent; sulphur, 0.06 per cent; graphitic carbon, 3 per cent; combined carbon, 0.3 per cent. Except for the phosphorus, it is seen this iron would correspond to a No. 1 iron in the United States. From 5 to 10 per cent of steel scrap is used in the rail-chair mixtures. As far as possible the cupola design and melting practice corresponds to the practice recommended by David McLain, Milwaukee, author of "McLain's System." The fuel used is English by-product foundry coke.

A well equipped laboratory is provided and the mixtures are made up by analysis. There is laboratory control throughout the process. A test-bar is cast with every heat and subjected to a transverse test. The bar is of the standard size, 1 x 2 inches, tested between 3-foot centers. It must withstand a concentrated load of 28 British hundredweights, or 3136 pounds.

After the castings are taken out of the molds they are set down on the floor and allowed to cool slowly over night. This gives a mild annealing action. They are then cleaned by hand, the sand being simply brushed off. One man is employed for this purpose on each floor. The finished rail-chair and brake shoe castings finally are handled in a steel scoop by the traveling crane that covers the delivery end of the foundry. The crane runway extends out into the yard as shown in Fig. 9, where the castings either are deposited directly into railroad cars for shipment, or are piled up in bulk for future disposition, as shown in the illustration.

The rail-chair castings are used around the Smith-Patterson foundries for various unique purposes. For instance, the hot castings are employed for drying ladles. They also are similarly used for skin-drying molds in the jobbing shop. In addition, they make excellent flask weights.

As previously mentioned, in addition to the rail-chair and brake-shoe specialty shop which has been described, Smith-Patterson & Co. operate extensive jobbing foundries in connection with their plant at Blaydon-on-Tyne. These foundries handle general jobbing work up to over 20 tons in weight. Turbine casings for turbo-generator sets are specialty. One of the products of department is a 22-ton casting now ing service as part of a Parsons bine installed in one of the plants the Commonwealth Edison Co., Chic

In order to be independent of t conditions, Smith-Patterson & Co. operate a coasting steamship of 350 tons. She is 135 feet long, 23 feet 6 inches beam, and 11 feet 3 inches in depth. This vessel was built by J. P. Rennoldson & Sons, Ltd., South Shields, England, for Smith-Patterson & Co. Originally named the BAYDONIAN, this little vessel had the distinction of sinking an enemy submarine during the war, and subsequently her name was changed to PATTERSONIAN.

British Foundrymen Meet Above Border

GROWING sentiment among British foundrymen to cooperate more closely with the foundrymen of the United States characterized the opening day's session at the annual meeting of the Institution of British Foundrymen held in Glasgow, Aug. 25-27. The members in attendance at the meeting voted unanimously to extend fraternal greetings to the American Foundrymen's association and to offer best wishes for the success of the Columbus convention. Before the meeting came to a close arrangements had practically been completed for the exchange of papers between the Institution of British Foundrymen and the American Foundrymen's association in 1921. The hope also was expressed that it may be possible in the not distant future to arrange an Anglo-American Foundrymen's convention at which men from both countries can meet and exchange views in a more intimate and personal manner than is possible under ordinary circumstances. Members of the institution who had visited the United States stated that the volume and scope of the American foundry industry together with the processes and systems that made such volume possible could not be realized except by actual presence and contact with American conditions. On the other hand they felt convinced that there were many commendable features about British foundry practice which would repay investigation and study on the part of foundrymen from across the sea.

The meetings for the presentation and discussion of technical papers were confined to two sessions held on Wednesday and Thursday mornings respectively, Aug. 25 and 26, at the Royal Technical Institute. Among the papers presented at the technical sessions were the following: "The Measurement of Casting Temperature in the Brass Foundry" by J. Arnot, G. & J. Weir, Ltd., Glasgow; "Science in the Workshop," by W. H. Cathcart, Blacksmith gold medallist of the British Iron and Steel institute, and "Future Research in Cast Iron," by J. H Andrew, professor of metallurgy, Royal Technical college, Glasgow.

The Wednesday meeting was preceeded by a business session at which the election of the new president, M Riddell, Watson Gow & Co., Falkirk, Scotland, was announced. The formal installation of the new secretary, W. G. Hollinworth, formerly secretary of the Society of Heating and Ventilating Engineers, also was announced.

The Glasgow branch of the institution headed by J. Macfarland, William Jacks & Co., Glasgow, acted as host. The entertainment features included a civic reception by the lord provost and magistrates of Glasgow in the municipal building on Wednesday afternoon, Aug. 25 and an excursion to Loch Lomond on Friday. Thursday afternoon, Aug. 26 the works of the Singer Mfg. Co., at Kilbowie, near Glasgow, was inspected. This plant is owned by a company affiliated with the Singer Sewing Machine Co. of the United States.

The officers elected for the ensuing term were as follows: President, Mathew Riddell, Watson Gow & Co., Falkirk, Scotland; senior vice president, Oliver Stubbs, J. Stubbs, Ltd., Openshaw, Manchester; junior vice president, H. L. Reason, Birmingham; treasurer, F. W. Finch (re-elected); secretary, William G. Hollinworth, London. The members of the council are E. H. Broughall, Coventry; J. Jewson, Eastdereham; Alexander Hays, London, and J. Shaw, Sheffield.

The membership of the Institute now totals 1603 and reflects a steady and constant growth. It represents practically half the total number of foundries in Great Britain and Ireland and the 1921 meeting will be held at Manchester.

Akron Plant Started

Operation of the new plant of the Taplin-Rice-Clerkin Co. was started recently. It is said to be one of the largest foundries in northern Ohio and will be able to handle 25 tons of iron a day. Ten months have been consumed in construction of the plant, the building and equipment representing an outlay of $150,000. It will give employment to 150 men, a majority skilled mechanics. The factory is 80 feet wide and 360 feet long. Included in the equipment is a double smelter and a monorail system operated by compressed air. The plant is electrically equipped.

SPECIFICATIONS FOR CAST-IRON SOIL PIPE AND FITTINGS

(Continued from Data Sheet No. 348)

Table II

WEIGHTS OF SOIL PIPE FITTINGS

Only the staple fittings are shown. From the data herewith the weights of other fittings may be calculated. All values are in pounds.

	Size of Fittings, Inches														
	2	3	4	5	6	3 by 2	4 by 2	4 by 3	5 by 2	5 by 3	5 by 4	6 by 2	6 by 3	6 by 4	6 by 5
¼ Bends, regular	6¾	10¼	15	19	23½										
¼ Bends, short sweep	8¼	12½	17¾	22½	27½										
¼ Bends, long sweep	10¼	15¾	22	27½	33½										
⅕ Bends	6¼	9¾	13¾	17½	21½										
⅙ Bends	6	9¼	13	16½	20										
⅛ Bends	5½	8½	12¼	15¼	18¾										
1/16 Bends	5	7¾	10¾	13¼	15¾										
Return Bends	8¾	14	20¼	26½	33½										
Tees	10½	15¼	21	26½	32½	13¼	16½	18¾	19¼	22	24½	22½	25	27½	30
Tapped Tees (tapped up to 2 in.)	8¾					11¾	15		17¾			20½			
Sanitary Tees	11	16¼	22½	28	34½	14	17¼	19¾	20	23	25½	23	26	29	31½
Tapped Sanitary Tees (tapped up to 2 in.)	9					12	15¼		18			21¼			
Y Branch	11	17	24	31½	39½	14	17¼	20½	20	23½	27½	23	27	31	35
⅛ Y Branch	10¼	15½	21½	27½	34	13½	16½	19	19½	22	25	22½	25½	28½	31
Tapped Inverted Y Branch (tapped up to 2 in.)	10¼	13¾	17½	21	24										
Inverted Y Branch	11½	18	25½	33	41½	15	18¾	22	22	25½	29½	25½	29¾	33	37
Combination Y and ⅛ Bend	12	18¾	27	35	44½	15	18¼	22½	21	25½	30½	24	29	34	39
Upright Y Branch	12½	19½	28	36½	46	15¾	18¾	23	21½	26½	31½	24½	29¼	35	40

(Concluded on Data Sheet No. 350)

SPECIFICATIONS FOR CAST-IRON SOIL PIPE AND FITTINGS

(Concluded from Data Sheet No. 349)

(c) All pipe and fittings shall be of uniform thickness of wall and present true circles at the hub and spigot ends. A variation of 1/16-inch under the following dimensions will be permitted, but only when the actual weight is not less than the variation of the manufacturer's or estimated weight as given in tables I and II:

THICKNESS OF BARREL	[illegible]
" " BODY OF HUB	[illegible]
" " BEAD OF HUB	[illegible]
" " BEAD OF SPIGOT END	[illegible]

9. (a) Weights and measurements of pipe and fittings shall be taken as those of plain uncoated pipe. All weights shall be given in pounds.

(b) Individual lengths of pipe and fittings may weigh 5 per cent less than designated in Tables I and II, but only when the average weight of a given size and weight of pipe and fittings selected at random is not less than that shown in Tables I and II.

(c) The regular length of pipe shall be such as to lay 5 feet including hub.

(d) The average weights of soil pipe and fittings shall not be less than those given in Tables I and II.

V.—WORKMANSHIP AND FINISH

10. (a) All pipe and fittings shall be practically straight and cylindrical and fittings true to pattern. The specified sizes shall be for the inside diameter and shall conform, within the allowable variation, to the dimensions given in the tables.

(b) All pipe and fittings shall be carefully examined for defects and sounded with a hammer before shipment. No fillings with metal, cement or other material, or so-called "burning on" of iron will be permitted. The castings shall be sound and free from cracks, sand holes, blow-holes and cold-shots.

VI.—MARKING

11. All pipe and fittings shall be marked with the name of the manufacturer, or appropriate initial. Each casting shall have cast upon it the minimum or estimated weight of same as shown in Tables I and II.

VII.—INSPECTION AND REJECTION

12 The manufacturer shall afford the inspector representing the purchaser, free of cost, all reasonable facilities to satisfy him that the castings are being furnished in accordance with these specifications. All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works and shall be made prior to shipment, unless otherwise specified.

13 All pipe and fittings which fail to conform to the provisions of these specifications shall be subject to rejection.

Judging Sands for Foundry Use-I

Three Main Characteristics Which Must be Present in Good Molding Sand Are Defined and the Methods for Their Determination Are Explained

BY HENRY B. HANLEY AND HERBERT R. SIMONDS

SAND for foundry use possesses three characteristics, refractoriness, cohesiveness and porosity. The variation of one or more of those properties adapts a sand for different classes of foundry work. Scattered throughout the United States and particularly in the eastern portion, natural sands are found which have the properties ideally suited to certain classes of foundry work.

Foundry sands may be divided under the following general headings: Molding sand; core sand; facing sand; fire sand; gravel; high silica sand; and parting sand.

Molding sand usually is a mixture of quartz, feldspar and clay, having peculiar properties of holding a bond when tempered with a small quantity of water. The term molding sand often covers facing sand, the difference in the two being merely one of refinement in the bond property. The facing or face surface of any mold is the main factor in determining surface finish of the casting and it follows from this that when refinement of finish of a casting is essential a specially fine grained sand is necessary. However, some foundries have eliminated any distinction between facing and molding sand, using a homogeneous mixture which is sufficiently fine to meet their surface requirements for all purposes.

Core sand usually is a straight silica sand, sometimes carrying from 10 to 35 per cent of feldspar, and containing little or no clay substance or other bonding material. In its final mixture it always is an artificial sand in the strict sense of the word, for the bond is obtained through a separate binding material which is mixed with the clean sand. Such an artificial binder usually is based upon linseed oil, molasses, glutrin, glucose, resin, dextrin, flour or a pitch compound.

In addition to these a great number of patented or trade mixtures have been placed on the market, composed of one or more of the following substances; resin, soya bean oil, fish oil, linseed oil, and mineral oil. The question of binders for core sands is extensive and will be treated at some length later.

Fire sand usually is a coarse silica sand carrying, only small quantities if any clay and feldspar. These, if present, are impurities, as the ideal sand is pure silica. Fire sand is mixed with fire clay to make cupola and ladle linings and for other refractory uses in the foundry.

Aiding Escape of Gases

Gravel is a coarse silica sand combined with clay to make its use possible as a molding sand. Its function is to increase the porosity of a mold to allow greater rapidity in the escape of gases from large castings. It usually is mixed with other sands. As castings approach the ton size, porosity of the sand in the mold becomes of great importance in molding.

High silica steel molding sand is pure quartz and runs from coarse to fine grades. It must be free from impurities which would cause fusibility. It always is artificially bonded.

Parting sand is a pulverized fine quartz sand usually of a fineness to pass a 100 mesh sieve.

Different grades of all the varieties of sand mentioned are required for different classes of work. For example, a molding sand of fine texture, smooth face and medium strong bond is well suited to stove plate work, whereas, for medium size cylinder work a sand of coarse character with a strong bond would be best suited. It is this shading in the required properties of sand for different classes of work in the foundry which has brought into prominence many producing districts, each renowned for the particular sand which nature has given it.

Sand throughout an entire district often has the same general characteristic; thus the Albany district sands run fine in texture and are adaptable to the stove plate industry, as they produce what is known as a sharp finish. On the other hand, the so-called Jersey district sands are coarse with high silica content and a strong bond, and therefore are adaptable to large castings. The sand deposits at the southern end of Lake Michigan in many cases are found to be pure silica and of a remarkably uniform size of grain. Southern Lake Michigan sand, on its way to the Atlantic coast passes each week or perhaps each day Jersey sand which is trav-

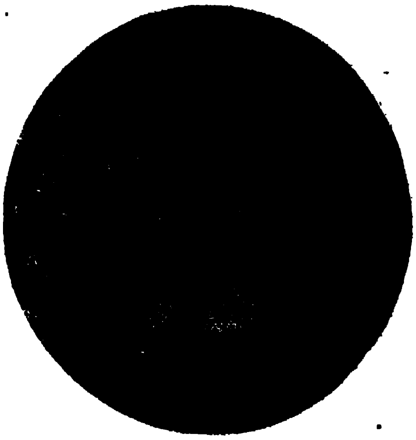


FIG. 1—TYPICAL MOLDING SAND MAGNIFIED EIGHT TIMES

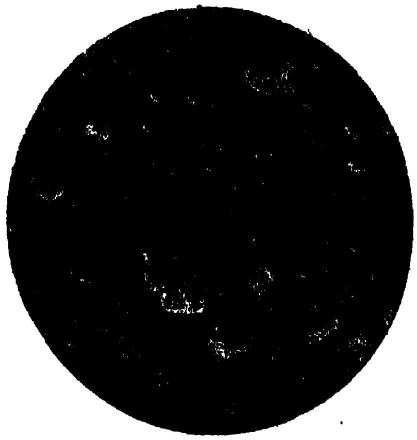


FIG. 2—TYPICAL CORE SAND MAGNIFIED EIGHT TIMES

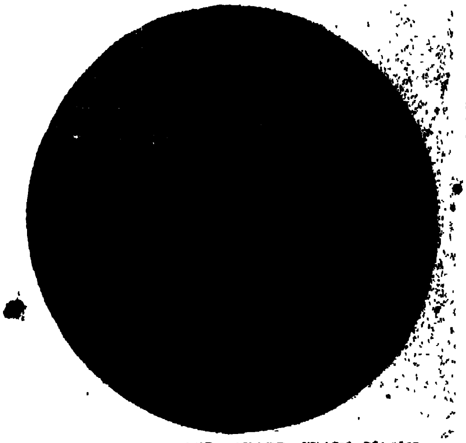


FIG 3 CORE SAND, SHARP GRAIN MAGNIFIED EIGHT

Henry B. Hanley is metallurgist for the New London Ship & Engine Co., Groton, Conn. Herbert R. Simonds is New England representative of THE FOUNDRY.

TABLE I
Chemical Analysis of Typical Sands

	*Molding Sand Per cent	†Core Sand Per cent	Facing Sand Per cent	Fire Sand Per cent	Gravel Per cent	‡Steel Sand Per cent	Parting Sand Per cent
Loss on ignition	3.05	.75	2.00	1.14	1.34	.45	.45
Silica (SiO_2)	82.10	95.25	88.52	94 00	84.18	97.55	98.01
Iron oxide (Fe_2O_3)	5.23	1.45	5.60	2.15	3.02	1.00	.30
Aluminum oxide (Al_2O_3)	7.70	.50	2.47	2.45	7.95	.61	.85
Calcium oxide (CaO)	.63	1.01	trace	trace	.44	.15	.10
Magnesium oxide (MgO)	.13	.42	.23	.08	.37	.21	.06
Sodium oxide (Na_2O)	trace	.15	.06	trace	.07	trace	trace
Potassium oxide (K_2O)	1.15	.10	.85	.05	2 51	trace	trace

*Medium.
†Coarse.
‡High silica.

eling west. Jersey sand has in fact been used quite extensively on the Pacific coast and was sent to Panama for making steel castings for the canal work. It has also been sent to the Philippines.

In almost any part of the United

but the composition when checked with the physical or mechanical properties will give an idea of the availability of the sand for the purpose sought. Table II shows the results of mechanical analyses of different sands. In addition to presenting an

and it is not uncommon to find foundrymen who do not at all understand such an analysis.

The methods of making complete chemical analyses of foundry sand are known to most chemists doing general analytical work. Such analyses consist in making quantitative determinations of the different elements oxides contained in the sample. complete analysis, however, without interpretation has almost no value. is not desired, for instance, to know the silicon content of a molding sand, for this alone, without some knowledge as to the form in which the element is combined in its physical state gives little idication of its effect.

On the other hand a careful chemical analysis *with* an intelligent interpretation is valuable to any foundryman. The silicon dioxide or silica

FIG. 4—COARSE FACING SAND MAGNIFIED EIGHT TIMES

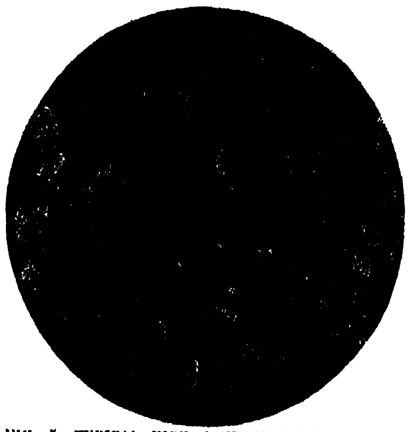


FIG. 5—TYPICAL FIRE SAND MAGNIFIED EIGHT TIMES

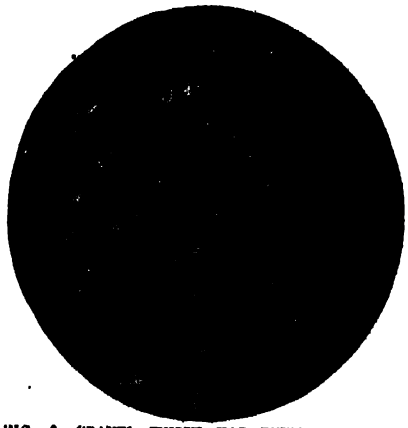


FIG. 6—GRAVEL WHICH HAS BEEN MAGNIFIED EIGHT TIMES

States a sand can be found close at hand which can be economically worked over to adapt it for foundry use. However, it must be understood that not all samples from the same district will have the same properties. Often it is possible to mix local sand with small quantities from a distant bank to produce the desired result. One of the great difficulties to overcome is the lack of uniform grain in most local or undeveloped pits. Where the lack of uniformity is not too pronounced sieves may be employed economically for grading. In the Far West there seems to be an actual scarcity of good foundry sand. However, there are materials in the back yard of almost any foundry which could be used to cut down the quantities of imported sand required, and which, without reducing the quality of castings, would effect a saving in freight charges and in molding sand costs.

From Table I, the general chemical characteristics of the different typical sands may be noted. Different sands may vary under chemical analysis,

indication of the relative fineness, this table shows the prosity or percentage of voids in the mass.

Foundrymen for several years have had before them the results of chemical analyses of a great many molding sands from all parts of the United States. Little use, however, has been made of this information, for the interpretation of a chemical analysis is rather difficult even for a chemist,

(SiO_2) is the factor which is valuable in a sand analysis

A chemical analysis usually gives only the determination of silica, alumina, ferric oxide, lime, magnesia, potassium oxide and sodium oxide. A typical chemical analysis of a molding sand appears in this form:

	Per Cent
Loss on ignition	3.38
Silica (SiO_2)	82.52
Alumina (Al_2O_3)	8.53

TABLE II
Mechanical Analysis of Typical Sands

	*Molding Sand Per cent	†Core Sand Per cent	Facing Sand Per cent	Fire Sand Per cent	Gravel Per cent	‡Steel Sand Per cent	Parting Sand Per cent
Sand retained on 20 mesh sieve	3.2	13.0	7.0	35.0	32.0	4.7	None
Sand retained on 40 mesh sieve	5.0	79.4	35.5	34.1	34.3	48.1	None
Sand retained on 60 mesh sieve	11.4	4.8	16.3	10.6	9.8	38.2	None
Sand retained on 80 mesh sieve	13.6	.6	4.8	7.8	1.1	5.2	None
Sand retained on 100 mesh sieve	6.2	.4	3.6	1.5	1.1	1.5	None
Sand retained on 150 mesh sieve	22.1	.5	2.1	1.8	1.3	1.0	10.5
Sand retained on 200 mesh sieve	9.3	.2	4.5	.4	1.3	.1	15.2
Fine silt 200 +	16.6	.8	10.4	2.4	3.6	1.2	74.3
Clay substance	12.1	.5	14.8	5.8	15.5		
Sharp sand	87.9		85.2		84.5		
Bond	12.1		14.8		15.5		

*Medium.
†Coarse.
‡High silica.

Ferric Oxide (Fe_2O_3)........	3.57
Lime (CaO)	.17
Magnesia (MgO)	.18
Potassium Oxide (K_2O).....	1.48
Sodium Oxide (Na_2O).......	.19

In looking over the percentages of he various constituents, misleading clusions often are formed. A high a content always has been under- to indicate that the sand was a refractory character, but after a ful study of this determination, and the possible combinations of silicates in a molding sand, it is seen that efractoriness is not necessarily dependent upon a high silica content in chemical analysis.

The silica reported represents all he silica in the sand. It may be derived from feldspar and various other silicate combinations, found in natural nolding sands. If the feldspar in a

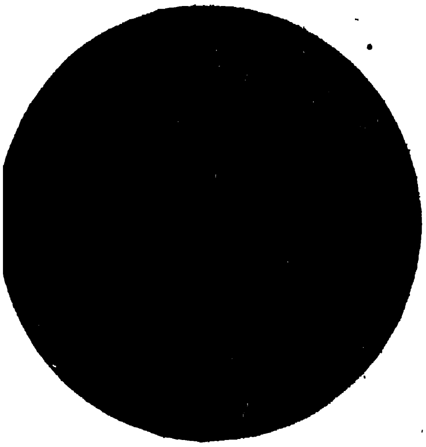


FIG. 7 - HIGH SILICON STEEL SAND MAGNIFIED EIGHT TIMES

sample runs high, the silica content also is high, but the refractoriness would not be as good as in a sample with low feldspar content, and perhaps a correspondingly low silica content. In the same way alumina, as indicated in the chemical analysis may represent part of the clay present, or of the feldspar, or of any other of several alumina bearing constituents occurring in natural sands. The general impression is that a high alumina content indicates a high clay sand, and thus a sand of strong bond. This impression is founded on two errors. The alumina may exist in constituents other than clay, or clay itself may be present with a comparatively weak bonding property. This naturally brings up the question of what is bond—which will be treated in detail in a later article.

Ferric oxide practically always is present as an impurity in natural molding sands, and its percentage, as shown by chemical analyses, often gives a good indication of the amount of bond in the sand. Ordinarily common sand, without bonding property, will show an iron oxide content of 5 or 6 per cent—whereas, in a molding sand the ferric oxide may run from 3½ to 15 per cent. The importance of iron content of a sand is not generally recognized, but from experience with a large number of sands with varying iron contents, it has been proved that a relation exists between the percentage of iron and the bonding quality. The iron content alone of course is not sufficient indication in some cases, for a sand containing 5 or 6 per cent may have almost no bonding property, or it may have a fairly good bond.

Lime and magnesia are classed as alkaline earths in a molding sand analysis, and their percentages should be as low as possible to avoid trouble arising from their fusion. They are melted easily and when present in any appreciable quantity they affect the finished appearance of the casting. Quantities up to 1 per cent of either lime or magnesia, will never give trouble. Sodium and potassium oxides usually are part of the feldspar content of a sand, and their percentages give a fairly reliable indication of the feldspar percentage. In any case these oxides are undesirable, for they are the most fusable of all the constituents. From this an idea is obtained of the importance of careful interpretation of a chemical analysis. A chemical analysis does not in any way indicate the physical properties of a molding sand, and since these properties are recognized as the most important, it is necessary, wherever possible, to supplement the chemical analysis with a mechanical analysis.

Mechanical Analysis

Steel sands and core sands carry no natural bond, being principally high silica grains, and the difference between one such sand and another, is not a question of composition, as much as it is of grain size.

The ultimate chemical analysis may be relied upon to serve as a discriminating guide between sands of different characteristics. A mechanical analysis of molding sand however, is easier to make, and gives far more practical information. No other test will give such an accurate indication of the grade of sand, the shape of particles, and the percentage of bond matter present. After a little experience, the mechanical test will closely indicate the working properties of a sand. The analysis commonly consists of a sieve test. Until recently, there has been no standardization of the number or size of sieves used in mechanical analysis work. Each individual must determine what is necessary for the work at hand. A great many of the fine stove plate sands contain grains that can be collected only on the 150 and 200-mesh sieves.

In addition to the chemical and mechanical analyses, a so-called rational analysis often is made to obtain information regarding the properties of the principal mineral constituents. This analysis shows the clay substance, the quartz and the feldspar. The clay substance is determined by separating out the feldspar and quartz from a sample of sand of known weight, and then subtracting the weight of the substances thus separated from the original weight of the sample. In a similar way the feldspar is determined by removing the silica. The difference between the weight of feldspar plus the clay, and the total weight of the

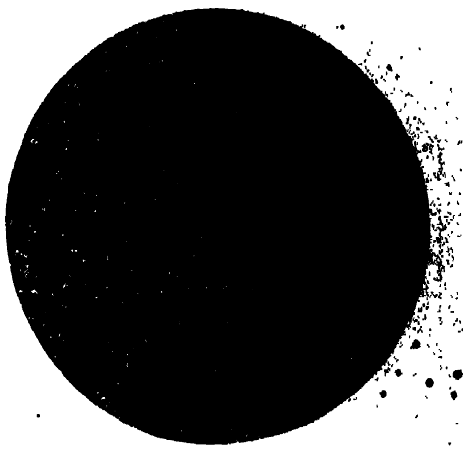


FIG. 8—PARTING SAND MAGNIFIED EIGHT TIMES

sample, gives an approximate weight of the quartz.

The rational analysis, while not accurate in any degree like the chemical or mechanical analysis, gives helpful data. It is a useful test in checking uniformity of sands from different localities. An experienced judge often can tell from a rational analysis, the locality from which the sand came. Sands high in feldspar fuse more readily than those of low feldspar content, and thus knowledge concerning the feldspar is of importance. The percentage of quartz found, through a rational analysis, indicates at once the approximate silica content, and this fact alone makes the rational analysis of great value in selecting sands for steel casting work, where the refractory quality is vital. The quartz content of a good refractory molding sand does not run below 90 per cent. The clay substance as determined in a rational analysis means little in regard to bond, since the method as used today is one of solution of soluble material in reagents, and not only the hydrated alum'num

TABLE III

Methods of Analysis for Sand

Determining Silica Content

ONE gram of a dried and finely powdered sample of molding sand is fused in a platinum crucible with 10 grams of sodium carbonate and 100 milligrams of potassium nitrate. After fusion is completed, the crucible is cooled, and the contents thoroughly disintegrated by the addition of hot distilled water. The contents of the crucible then is transferred to a large platinum pan where it is acidified with hydrochloric acid, and afterwards evaporated to dryness. The residue thus obtained is heated at 135 degrees Cent. for several hours to remove the last traces of hydrochloric acid, and to dehydrate the silica. Next the residue is treated with 5 centigrams of hydrochloric acid which is allowed to act 5 minutes, then the whole is diluted with 95 cubic centimeters of distilled water and placed on a steam bath to dissolve all the salts. Silica remains and is filtered off and washed with hydrochloric acid and hot distilled water, until free from iron. After washing, it is dried, ignited and weighed. This weight represents the total silica contained in 1 gram of the molding sand.

Aluminum and Iron Contents

ALUMINUM and iron oxides are obtained from the filtrate from the silica determination. This is diluted to 250 cubic centimeters by the addition of distilled water and a slight excess of ammonia is added. The solution then is boiled for a short time and allowed to settle. The precipitate, which consists of iron and aluminum oxides, is filtered off and washed with warm water, containing a little ammonia. It is then dried, ignited, and weighed. The result represents the total amount of combined iron and aluminum oxides contained in 1 gram of molding sand.

These oxides may be separated when desired, by use of hydrochloric acid and a zinc reductor. To do this, the combined oxides are placed in a platinum crucible with 10 times their weight of sodium carbonate, and the mixture is fused. The mass thus formed is dissolved in hot water, which has a small quantity of hydrochloric acid added to it. The iron is then reduced by running the solution through the zinc reductor and the ferrous content is titrated against potassium permanganate, and calculated to ferric oxide. This result when subtracted from the combined weight of iron and aluminum oxides gives the weight of the latter.

The filtrate from the separation of iron and aluminum may be used for the determination of calcium. For this five cubic centimeters of concentrated ammonium hydrate are added, and the solution is heated to boiling, when five grams of ammonium oxilate are added. This solution is usually kept boiling for 10 minutes as the calcium oxilate comes out of solution slowly. When the solution has cooled and cleared, it is filtered and then thoroughly washed with hot distilled water. The precipitate is calcium oxilate, which is dissolved in weak sulphuric acid, and titrated against potassium permanganate. From the amount of the permanganate used, the percentage of lime in the sand is readily calculated.

Determining Magnesia Content

THE filtrate is used for further determination and the next logical step is the magnesia test. The filtrate from the lime test is acidified with hydrochloric acid, and 2 grams of sodium phosphate are added. The whole situation is then evaporated until it has been reduced to 150 cubic centimeters. Next ammonia is added until the solution is neutralized, after which 10 cubic centimeters of ammonia is further added, in excess of neutralization. The solution is then cooled and thoroughly shaken, and ammonia magnesium phosphate slowly precipitates out. It is allowed to stand over night and is then filtered through a Gooch crucible, washed with 10 per cent ammonia, ignited and weighed. The result gives magnesium pyro-phosphate, which multiplied by 0.3619 gives the magnesia in 1 gram of the molding sand.

Determining Sodium and Potassium Contents

FOR the sodium and potassium oxides, a fresh sample of sand is used. Two grams are dried and finely powdered, and heated with a mixture of one part of ammonia chloride and eight parts of calcium carbonate. By this means the alkalies are obtained in the form of chlorides, while the remaining constituents are for the most part, left behind as oxides. The silica is changed to calcium silicate. Alkali chlorides, together with the calcium chlorides, can be removed from the sintered mass by leaching with water. The other constituents remain undissolved. The sintering is carried out by gradually raising the temperature under a platinum crucible, until the lower portion of the crucible is brought to a dull red heat. This temperature is maintained for about one hour, after which it is allowed to cool, and the sintered cake is removed by gently tapping the crucible. The cake is then heated for about one hour with 50 to 75 cubic centimeters of water in a large platinum dish. It then is broken up into a fine powder by rubbing with a glass pestle, and is again washed and filtered until the filtrate gives only a slight turpidity with silver nitrate. The filtrate is then treated with ammonium hydrate and ammonium carbonate and heated and again filtered. The precipitate contains small amounts of alkalies, and is, therefore, redissolved in hydrochloric acid, and the previous precipitation repeated. The combined filtrates are evaporated to dryness in a porcelain dish, after which, careful ignition over a moving flame removes any ammonium salts which may be present. The residue is cooled and dissolved in a little water, and the last traces of calcium are removed by the addition of ammonium hydrate and ammonium oxilate. Calcium oxilate is then obtained by filtering. The filtrate is evaporated to dryness, ignited and weighed. Further refinements are necessary for careful work, but this weight represents the amount of alkali chlorides present with fair accuracy.

To separate the potassium, the residue is redissolved in water. The potassium is then precipitated as potassium chlorplatinate, filtered through a Gooch crucible, dried and weighed. This weight is then calculated to chloride, from which the weight of oxide can be obtained.

silicate (clay) but other silicates which are soluble, pass into solution and are reported as clay substance. Therefore, the clay determination through rational analysis must be used with care.

Bond Absorption Test

A more reliable test for determin[ing] bond is known as the bond absorp[tion] test. This consists of introducing c[rys]tal violet dye into a solution cont[ain]ing the colloidal matter of a sa[nd] sample. This dye has the peculia[r] property of being absorbed by colloidal substance in a definite and constant amount proportional to such substance. Thus a definite amount of colloidal matter is necessary to take up a definite weight of crystal violet dye. After having obtained a solution of colloidal matter, the method of determining the weight of dye which it will absorb is briefly, as follows:

Dye crystals gradually are added until after thorough mixing, a slight tin[t] remains constant in the solution. This means that more of the dye has been added than can be taken up by the colloidal substance. The same tint which exists in the solution under test is then obtained by introducing a known amount of dye into pure water solution. The amount of dye absorbed by the colloidal matter then is th[e] total weight of dye introduced int[o] the solution under test, less the weigh[t] in a water dye solution, having th[e] same tint. Some inaccuracies develo[p] in this test, due to the fact that sus[]pended matter remains in the liqui[d] containing unabsorbed dye, and thi[s] prevents an accurate tint comparison A refinement of the test is possible however, for the dye can be completel[y] taken out of solution by mordante[d] cotton yarns.

Test is Accurate

It is safe to say that no other phys[]ical test gives so close an estimat[e] of the quality of bond of a moldin[g] sand as does this one of bond absorption. It provides an almost perfect means of comparing the actual quality of bonding material of one molding sand with that of another. However, the test when used on widely different grades of sand is not infallible as ordinarily conducted. This is due to the fact that some colloids affect the absorption of dye stuffs from the solution in a different manner from others. Fortunately in the majority of cases this difference in effect is not sufficient to introduce a detrimental error. The amount of bond substance existing and the strength of bond of a molding sand are, contrary to the general impression, not directly related, and it is this fact, more than

FIG 9—STIRRING MACHINE FOR ROTATING JARS IN BOND ABSORPTION TEST AND MECHANICAL ANALYSIS FIG. 10—TRANSVERSE TESTING MACHINE FOR STRENGTH TEST ON SANDS

any inaccuracies in bond adsorption tests, which has introduced error into the work of many investigators. The bond itself is influenced by the surface area of the sand as a predominating factor. For instance, the bond test performed on a sample of sand, will indicate a definite quantity of colloidal matter present; yet the surface area of the sample may be low, if the sand is coarse, or may be high, if it is fine, and the bond will vary accordingly.

Imagine the total surface area of the sample, that is, the area of the surface of each individual grain, spread out and pieced together to form a flat surface. Such a surface made up from a coarse sand would be small, and from a fine sand, large. Therefore, if there is the same amount of colloidal matter to spread over one surface as the other, then it is obvious that the smaller surface will receive the thicker coating, which means that it would have a stronger bond. In other words, with a definite amount of colloidal matter present in a sand, the coarser the grain, the stronger the bond. This is true within ordinary limits. In a sand which is too coarse the effect of reduced contact area between the particles tends to counteract the increased bond density.

Results of the bond adsorption test always must be linked with data concerning the grain size of the sand, otherwise, the test is relatively valueless. This introduces the term, density of bond. The amount of colloidal matter divided by the surface area of a sand gives the bond density, and this furnishes a much more reliable guide to relative bond strength of sands, than any other single quality.

An additional point to consider irrespective of areas, is the shape of grains and the amount of void. The effect of variation in these qualities on the cohesion of sand particles in a mold can be determined to some extent through experience with different sands. The amount of void may be approximated from the results of a sieve test. Evenly graduated amounts remaining on the different sieves indicate a low void. That is, if a curve were drawn representing the amount of sand remaining on each successive sieve, a smooth line continually increasing or decreasing from the coarsest sieve to the finest sieve, would show a sand to have far less void than an irregular line running up and down from one sieve to the next.

Transverse Test

As a further indication of bonding value of sands, a transverse strength test is often made. This has proved to be an interesting line of investigation, and frequently develops information of value in checking the strength of heap and facing sand on the foundry floor. The details of this test may vary a great deal, but the method always is the same, and consists of making up specimen briquettes which are later tested for transverse breaking load, much as a beam would be tested. The test serves as a guide to the strength of sand, whether or not the sand is new or has been in use for making castings a number of times, and is important for this reason.

With the intention of bringing the foregoing tests within the scope of almost any plant, some detail of apparatus is presented in the accompanying Fig. 10. In the usual chemical analysis the determination of silica is made as shown in Table III.

The loss in weight on ignition is obtained for a sample of sand by heating one gram of the finely powdered sand in a platinum crucible for one-half hour, over a high temperature bunsen flame. The crucible then is cooled in a desicator and weighed. The difference in this final weight and 1 gram, represents the water of hydration, the organic and the volatile matter present in the sand. These determinations constitute the chemical tests most easily made in a typical analysis. The rare constituents present seldom are determined, as little is known concerning their effect when present in molding sand.

The mechanical analysis, or sieve test, may be made as follows:

Weigh 25 grams of sand in a 500 cubic centimeter bottle, and add 250 cubic centimeters of water containing 25 milligrams of caustic soda. A glass stopper is sealed in the bottle, and it is then placed in a rotating machine, where it is stirred for one hour. One form of such machine is shown in Fig. 9. This process separates the clay substance and the colloidal matter from the grains of sand. After the separation is complete, the sand is washed onto a set of sieves, in sizes varying from 20 to 200 meshes per square inch. A strong stream of water is played on each sieve, and this forces the small particles with little difficulty through the coarser sieves, so that the entire operation may be completed in 10 minutes. The apparatus for this is shown in Fig. 11. The clay substance and the colloidal matter are so finely divided that they remain in suspension in the wash water. This is stirred and allowed to settle for five minutes, and then decanted off. When all the sharp sand has been separated in this way and accounted for, the difference between the total weight and the amount of material taken, represents the clay substance and colloidal matter present in the sand. Although no standard has been adopted for the sizes of sieves employed in mechanical analysis, a convenient arrangement consists of the following sizes:—20, 40, 60, 80,

100, 150 and 200 meshes per square inch.

The rational analysis for the determination of clay is made as follows: One gram of finely ground and dried molding sand is weighed into a 150 cubic centimeter glass beaker and 15 cubic centimeters of concentrated sulphuric acid are added. The mixture is stirred well, and allowed to digest for 12 hours at a temperature high enough to make the acid fume.

The solution then is cooled, diluted with 100 cubic centimeters of 10 per cent caustic soda solution, after which it is boiled for 30 minutes, then filtered a second time through a gooch crucible, washed with 1 per cent solution of caustic soda, and finally washed with about 90 cubic centimeters of 25 per cent hydrochloric acid. The residue is washed with hot water until the washings are free from chloride.

FIG. 11—APPARATUS USED IN MAKING SIEVE TEST

It then contains the feldspar and the quartz, and when burned to constant weight, gives a value which subtracted from 1 gram, closely indicates the weight of clay substance in the sample.

To separate the feldspar from the quartz in this residue, it is fused in a platinum crucible with five times its weight of sodium carbonate. After complete fusion the mass is placed in a beaker, and dissolved in water, the solution is acidified with hydrochloric acid, and evaporated to dryness to remove silica. Next the residue is treated with 5 cubic centimeters of concentrated hydrochloric acid, and 100 cubic centimeters of water. This solution is brought to a boil which permits the silica to be filtered off. The filtrate contains the alumina of the feldspar. This is removed by neutralizing the acid solution with ammonium hydrate, boiling for a few moments, and filtering. The precipitate is washed with hot water containing a few drops of ammonia, then dried and ignited. This precipitate is aluminum oxide, and since feldspar contains 18.34 per cent of aluminum oxide, the total amount of feldspar in the 1 gram of sand, is approximately 5½ times the weight obtained. The amount of quartz in the sample is closely indicated by the difference between the feldspar and the clay, as determined through the test mentioned.

The bond adsorption test is made by placing 25 grams of the prepared molding sand into a 500 cubic centimeter, wide-mouthed bottle, and adding 250 cubic centimeters of distilled water, and 5 cubic centimeters of 10 per cent ammonium hydroxide. The bottle after sealing with a glass stopper and parraffin wax, is placed in a rotating machine for one hour. At the end of this period, 140 cubic centimeters of distilled water are added, together with sufficient acetic acid to neutralize and leave an excess of acid. This usually requires 5 cubic centimeters of 10 per cent acid. In this state, the surface of each microscopic particle of the colloidal matter attracts or absorbs the dye. Sufficient dye is added to insure a slight excess, after the complete adsorption. The bottle is then sealed and agitated in a rotating machine for two hours. After removing the bottle from the machine, it is allowed to stand for a few hours, until the coarser particles have settled to the bottom. A beaker is then filled with 100 cubic centimeters of the top portion of the liquid, together with 25 cubic centimeters of water and two cubic centimeters of 10 per cent acetic acid.

Removal of Dye

While the beaker is held at room temperature, a 5-gram skein of mordanted cotton yard is introduced. The temperature is then granually raised through a period of 40 minutes to 60 degrees Cent., by which time, through careful movement of the skein, all the dyes should be removed from the solution, and the suspended matter from the molding sand should be left behind. The skein is washed and dried at 75 degrees Cent., and a comparison of its color against a standard set of skeins, gives the amount of dye which has been taken from this solution. The usual arrangement of standard skeins is made by depositing on each of six skeins 6, 8, 10, 12, 14 and 16 milligrams of crystal violet dye.

To make the transverse test, 400 grams of molding sand are tempered with water, up to the point where the sand is saturated. It then is rammed in a cement briquette mold, such as shown in the center of Fig. 10. A standard mold gives a 1 x 1-inch cross section at the center. The specimen after being removed from the mold is dried over night and then held for three hours at 100 degrees Cent. in an oven. After this, the specimen is set up in a suitable transverse testing machine. Such a machine should have a breaking capacity from 1 to 150 pounds per square inch. A convenient form of machine is shown in Fig. 10. The briquette is introduced at the left, and shot from an upper container, near the end of the lever arm is allowed to gradual run into a lower container, suspen from the arm. At the point of ture the flow of shot is immediatel shut off, and the weight of that the lower container, indicates th transverse strength of the briquette.

It will be seen from this, that a great deal of work is involved in the complete examination of a sample of molding sand. The straight mechanical analysis test which can be readily made by any one, through the use of the simple equipment shown in Fig 11, will give a great deal of helpful information to the molder. In fact, for venting problems, this test is all that is required. In dealing with the problem of bond, however, reliable determination can only be made through a combination of the bond adsorption test, the mechanical analysis, and the transverse strength test.

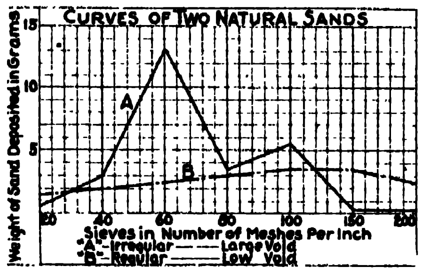


FIG 12—COMPARISON CURVES OF TWO NATURAL SANDS

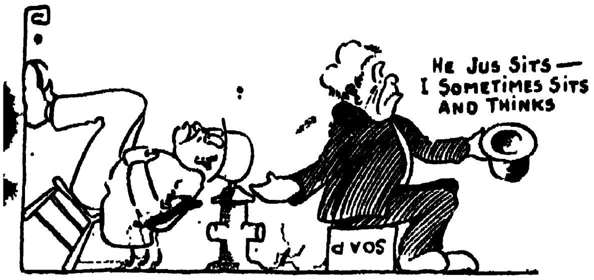
Buys Respirator Patents

Willson Goggles Inc., makers of industrial eye-protectors announce the purchase of all patents, trademarks, machinery and good will of Walter Soderling, Inc., 347 W. Broadway, New York, makers of respirators. Hereafter, respirators covered by the patents of the latter company will be manufactured at the Willson factory, Reading, Pa., under the personal supervision of Walter Soderling.

The University of Wisconsin offers its engineering students special facilities for becoming familiar with electric furnace operation. The electric furnace laboratory contains a heroult and a girod furnace of 450 and 150 pounds capacity respectively, besides smaller furnaces for making ferro-alloys. An electric brass furnace will be installed shortly.

Bill Takes the Bait of the Promoter

BY PAT DWYER



THE story has been credited to different people at various times but I first saw it in the *Youth's Companion* many years ago and you know how first impressions influence one. That magazine claimed that Norman Duncan brought it back from up Labrador way, where he spent several seasons visiting and gathering material for some of the stories which later made him famous. The episode to which I refer occurred in one of the little hamlets which are scattered at infrequent intervals along the coast of Newfoundland from Cape Race to the Straits of Belle Isle. These communities are as far removed from contact with the outside world as if they existed on another planet. Passing in front of the only store in the place one day Duncan saw several men sitting on a bench by the wall. He attempted to engage one of them in conversation, but experienced considerable difficulty in finding a topic of interest. Finally he asked how the men whiled away their spare time and received the astonishing, if somewhat philosophical piece of information "Oh, sometimes we sits and thinks and sometimes we just sits."

I was just sitting the other night, my mind a delightful blank, and with nothing to bother me as far as I knew until the whistle should blow in the morning. I was brought back to the cruel realities of life by a very young lady who perched herself on one arm of my chair and who told me in that peculiar form of language which very young ladies pick up, no one knows where, that she was up a tree and did not know how to get down. I replied properly that young ladies should not climb trees, but since she was in that embarrassing position the best thing she could do would be to creep out along the limb and drop off. This well meant and fatherly piece of advice apparently went over her head for she not only failed to move, but held up for my inspection an arithmetic and a scribbler and directed my atention to a question in the former which she claimed had been the cause of sending her up among the branches. I read the question over carefully and gathered that the kind old gentleman who had written the book had dug a cellar 20 x 40 x 6 feet deep and he wanted to know how many cubic feet of concrete would be required to build a wall 2 feet thick around this cellar. He also expressed a desire to be told how much the job would cost at $3 per cubic yard. I pointed out to the young lady that the man should have found out all those things before he started the job, any concrete man could have advised him, and privately I had my doubts about his being able to get any person to supply concrete at that figure. I then proceeded to elaborate further on the theme by pointing out that the specifications were too indefinite. They did not state whether the owner or the contractor was to supply the lumber and build the forms. There was no time limit set and there was nothing said in reference to the relative proportions of cement, sand and rock, factors which generally are recognized as exercising a direct influence on the cost of concreting operations.

Several other points which might have been touched upon with pleasure and profit were not alluded to because the young lady's mother, who is gifted with a singularly direct manner of speech, if you get what I mean, said to me "Why don't you tell the child what she wants to know instead of trying to air your knowledge of who's who and what's what in the concrete industry?"

While debating in my mind whether the retort courteous would be in order or whether I should follow the line of least resistance and say nothing as usual, the door opened and Bill entered.

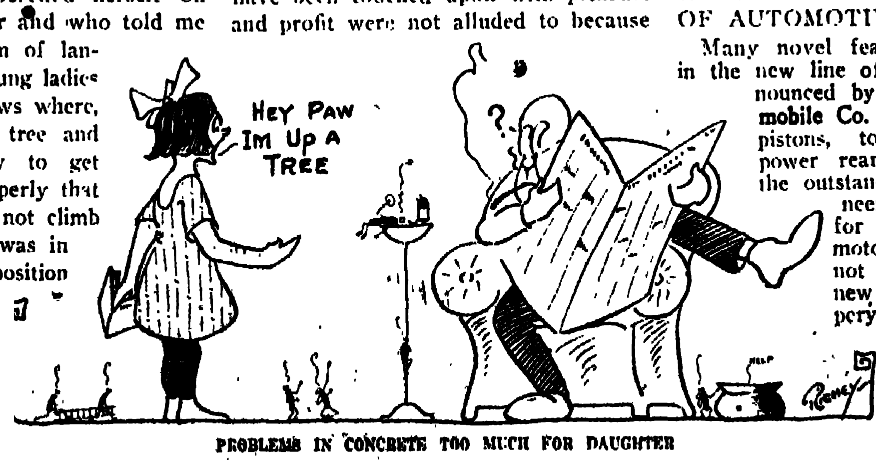
"Greetings" said he. "Greetings and salutation, I trust I am not intruding or interrupting a little friendly seance."

With the laudable intention of aggravating the lady who hates nothing so much as reiteration, I carefully went over the facts in the case under discussion prior to his arrival and at the conclusion asked his opinion on the subject.

"Well now," said he. "That is what I call a coincidence. I came over on purpose to show you a clipping from the old home paper. It is the most extraordinary thing I have ever read." He handed me the clipping from the *Apahaukee Advocate* and while I was reading it he took the little girl on his knee and showed her two different methods for working her arithmetical problem.

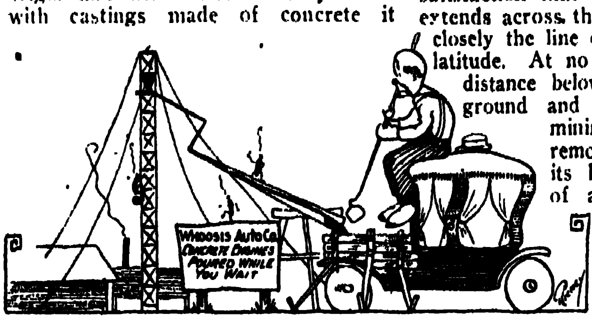
The clipping was headed RADICAL DEPARTURE IN AUTOMOBILE ENGINE CONSTRUCTION—TURBINE PRINCIPLE SUCCESSFULLY APPLIED TO PROPULSION OF AUTOMOTIVE VEHICLES.

Many novel features are embodied in the new line of trucks recently announced by the Whoosis Automobile Co. Concrete motors and pistons, together with water power rear axles are perhaps the outstanding features. Engineers have experimented for years with concrete motor construction but not until the advent of a new and exceedingly slippery cylinder lubricant has the proposition become practical. The oil has such a bearing on the feasibility and success of the



PROBLEMS IN CONCRETE TOO MUCH FOR DAUGHTER

motor that a word about its origin may prove of interest. Away back in prehistoric times before whales and other warm blooded animals had become accustomed to water, millions of them were drowned in a great flood. In the course of time the waters receded leaving their huge bodies resting on the dry land. The direct action of the sun caused the blubber to liquify and permeate the sands making what the geologists call a whale shale formation. It will thus be seen that this oil is of animal rather than a mineral origin and when used in conjunction with castings made of concrete it transforms them into shale once more —a very slipperly substance.



NO HOT METAL TO POUR HERE

The Whoosis trucks are not provided with transmissions as the term usually is understood. Power is transmitted to the rear axle, but not through a shaft and set of gears. The motor operates a pump which forces water under tremendous pressure into a tank under (not on) the driver's seat. Any person who is competent to water a lawn can safely be entrusted with the duties of driving one of these trucks. The first models built are for right handed drivers, but it is proposed to develop another model for the benefit of those who do not know their right hand from their left. To start the car the driver simply turns a valve which admits water from the tank to a turbine on the rear axle. After its force is spent the water is returned to the pump by gravity and may be used over and over again until it has lost its viscosity and therefore has no kick in it.

Particular attention is called to the air line bodies. The Whoosis people believe that they are the first in the field to introduce the beautiful into truck design and point with pride to the extremely pleasing effects produced by the dump body, job *A*, stream line Fleetwood creation with an elegant cab top, a la Michael Angelo, and side curtains by Lucille and Lady Dandelion-Dutton who collaborated throughout on the color scheme and the quality of the fabric.

The Whoosis company is to be congratulated on its commendable enterprise in carrying this proposition to a successful issue and making it a commercial success. Immense factories have been built and equipped at the outcroppings of the Portland cement mother lode on the Atlantic and the Pacific, one at Portland, Me., and the other at Portland, Oreg. Expert surveys have proved to the company's satisfaction that the cement formation extends across the continent, following closely the line of the 45th parallel of latitude. At no place is it any great distance below the surface of the ground and the open system of mining will be employed in removing the cement from its bed. In consideration of a 99-year lease of a right-of-way from the federal government the company binds itself to remove the cement in two parallel strips with an intervening body of land left between them. In the bottom of the first strip a 6-inch thickness of cement will be left undisturbed and will serve as a national highway across the continent, while the other will tap the Great Lakes and form a continuous canal from the Atlantic to the Pacific, and cut off approximately 6000 miles from the passage of water borne freight between eastern and western sea-board points. The Whoosis company is contemplating the construction of a fleet of giant trucks and another of huge self-propelled barges, both equipped with their famous double action toggle jointed, reversible, slippery concrete engines, and expects eventually to carry all transcontinental freight. No provision is being made for taking care of passenger traffic, because to quote the president, Mr. McWho: 'The substitution of concrete for cast iron in automobile engine construction is bound to revolutionize the industry and place the automobile within the reach of every one. I look forward confidently to the day when the automobile will be considered as much a part of the furnishing for a home as a stove, a bed or a victrola!'

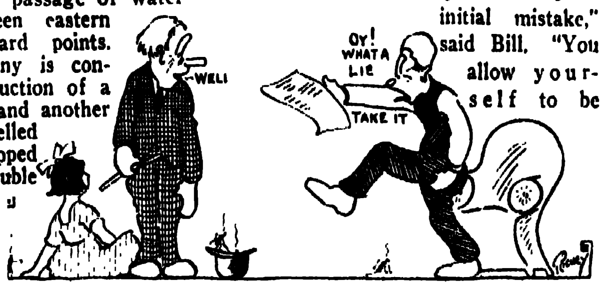
"Well" said Bill, when I had finished reading this remarkable statement and had handed the paper back to him: "How does the proposition hit you?"

"To tell you the plain unvarnished truth," I said, "It appears to me that it would require at least two strong men to believe that remarkable narrative. I often have heard of automobile engines in the abstract but this is the first time I have ever heard of one in concrete."

"Quite so," said he, "Quite so, my dear Watson, I think that I have frequently pointed out to you that you lack the gift of imagination. You are fairly reliable in grasping the details and analyzing what is perfectly obvious; but in the finer points of the game, in formulating theories based on facts which are not readily discernible; in constructing hypotheses; in drawing inferences and deductions you are sometimes singularly—er—if you will pardon the expression—er—obtuse. Please pass the cigarets."

"All right," I said, "I'm thick, I'll even go further and submit to being the goat if you can show me how that hare brained proposition can be taken seriously by any normal person."

"That is just where you make your initial mistake," said Bill. "You allow yourself to be



IMAGINATION OR PREVARICATION?

prejudiced against the thing in the first place and therefore you look at it through biased eyes. Your judgment is warped and you jump to conclusions without inquiring into all the circumstances surrounding the case. Let us consider this thing carefully, taking it point-by-point in an impersonal manner. I am inclined to think that the proposition is not so

NOTHING INTERRUPTS BILL'S DREAM OF CONCRETE MOTORS

utterly impracticable as you seem to think.

"In the first place the statement appears in a perfectly reliable newspaper, one of the bulwarks, as we often proudly assert, of our civilization. You know that not more than 99 per cent of the statements in our newspapers are ever successfully contradicted or denied in later editions; and therefore this statement has mathematically one chance in a hundred of being the truth.

"Then the name of the company, the Whoosis Automobile Co., what a musical liquid sound it has. By placing the accent on the last syllable of the first word you can almost hear the water leaving the discharge end of the pipe and impinge with resistless force on the vanes of the turbine. By placing an imaginary interrogation point after the word, one could imply a certain amount of doubt in the company's integrity, but that implication is too far fetched to be worthy of serious consideration.

"We now come to what in my opinion is the most convincing item in the whole chain of evidence. I refer of course to the drowning of the whales. There is abundant evidence both in sacred and profane history to support this statement. If my memory serves me correctly you will find in Genesis VII, 21-23 a detailed account of that interesting if somewhat melancholy event. There is no direct statement to support the theory that the whales all perished in one place, but you are familiar with the saying, 'Birds of a feather flock together,' and while it is true that a whale is not a bird, it must be borne in mind that the expression is always used in a generic sense and is just as applicable to whales as it is to the poor fish who usually prompt people to make application of the proverb."

The lady who does me the honor of wearing my name and spending my money and who as I remarked before speaks directly to the point took it upon herself to gum up the works by remarking:

"Bill, I hate to turn you out in the cold and the darkness, but here's your hat and there's the door and when you get home you can tell your wife that she has my sympathy in having to flock with a bird like you. I have heard some birdie stories in my time but that is the limit."

"All right" said Bill with a grin as he winked at me, "I'll be on the way but don't be surprised if I come back in a week or so to sell you a concrete block of stock in the Whoosis Automobile Co., of America, Inc."

Coal for Facing Becomes Difficult to Secure

SEA-COAL facing is an article employed in practically every foundry devoted to the production of gray-iron castings. It is mixed with the sand which comes in contact with the pattern, in varying proportions. These range from 1 to 6 in the case of heavy castings up to 1 to 12 for light work. The gas evolved by combustion, when the molten iron comes into contact with the coal in the sand forms a cushion between the molten iron and the sand of the mold prevents the metal from burning into the sand. A limited number of castings are produced in molds in which no sea-coal facing is used, but the great majority of casting users insist on a clean, smooth face and this feature necessitates the use of sea-coal in the facing sand. The amount used in various foundries ranges from one ton or even less a month in the smaller foundries up to 200 tons a month in some of the large automobile shops.

Two of the largest manufacturers each produce 8000 tons a month of this commodity while a third supplies approximately 4000 tons. In addition to these large companies several smaller companies turn out a considerable quantity and a few foundries have mills in which they prepare their own facing. A conservative estimate places the entire monthly consumption of sea-coal facing in the United States and Canada at 25,000 tons.

This is a comparatively insignificant amount when compared with the millions of tons of bituminous coal raised from the mines every month, and ordinarily no difficulty was experienced in securing all the coal necessary for foundry purposes. However, at the present time, owing to a variety of causes, it is becoming increasingly difficult, and in some cases impossible, to secure coal enough to keep the facing mills operating. The supply houses report unfilled orders dating back from one to six months. One house shipped 31 tons last week completing a 200-ton order book last April.

A scarcity of rolling stock and the recent priority orders of the interstate commerce commission are directly responsible, among other things, for the acute stage in the facing situation. Under a ruling of the commission the railroads are guaranteed a supply of coal, while the amount has to be rushed through the lake ports on its way to the Northwest before navigation closes, places a heavy burden on the coal distribution facilities of the country. It is not a question of the mine owners' ability to raise the coal from the mines. That point is conceded when it is realized that many mines are operated only two days in the week; not from any lack of desire on the part of the owners or from a scarcity of labor, but simply and solely because no cars are available to take the coal away.

The contention is sometimes advanced that it would tend to stabilize production and shipping conditions if the mining companies maintained a steady and fixed output for every working day. When the required number of cars was not available the surplus coal could be *banked* as it is in some mining regions in other countries and this reserve could be drawn upon when cars were plentiful and conditions warranted.

The objections to this idea are that a large space would be required to store the coal; it deteriorates more or less from adverse weather conditions and therefore is not so marketable; it would require additional and expensive machinery and equipment to unload the coal and reload it later, thus adding to the cost of production, and there is always the danger of spontaneous combustion. Whatever the reason, the fact remains that no reserve stocks of coal are maintained at the mines. Coal is raised when cars are available and when there are no cars the mine remains idle.

A few mines favorably situated near navigable rivers are equipped to ship both by rail and water and thus are enabled to operate practically every working day. These mines of course with their overhead expense distributed over 4 or 5 days a week are enabled to produce coal at a much lower cost than the mines operating two days a week and forced to apportion their overhead on that basis. Since there is no competition, the more favorably situated mines receive the same price for their coal which the two-day a week mines have been forced to set on their product to enable them to stay in business.

The small wagon mines, so called because their product is hauled away in wagons or trucks, are not included in the priority order issued by the interstate commerce commission and consequently coal from these mines can be bought in the open market.

However the output of these mines is limited and their prices are based on prevailing market conditions. Neither coal producers, or buyers are making contracts and there is no prospect of an easing in the coal situation until the end of November when the ports of the Great Lakes will be officially closed to navigation.

Customers for sea-coal facing are complaining bitterly that the supply houses are increasingly delinquent in filling orders and are even frequently refusing to accept orders as well as charging greatly increased prices for the limited amount of material which they do deliver. The supply houses on the other hand declare that they cannot get the coal and are forced to pay exorbitant prices for the comparatively small amounts which they they can pick up here and there. They are refusing to accept a great volume of business and the orders they do accept are based on the understanding that the customer will pay any increased price necessary to secure the coal in an uncertain market. In no case is any definite delivery date assured.

Scientific Methods Needed in Foundries

BY DR. JOHN E. STEAD

MANY years ago, when lecturing on science in the foundry, on one occasion I astounded the foundrymen present by the statement that, until the foundry industries appreciated the fact that the services of a trained metallurgical chemist were at least as necessary as those of a time-keeper, there was no hope for them. Today nearly every large foundry depends on the chemist for the synthetic control of the iron charged into the cupola, and the smaller establishments, where the output does not justify the establishment of a chemical laboratory, recognize that it is necessary to know the composition of the various consignments of raw material delivered to them, and would indeed be thankful if the pig iron manufacturers would supply them with analyses of all consignments. Few can conceive what prejudice existed a few years ago in the minds of those who controlled the mixing of metals in the iron foundries. These gentlemen did not realize that although the fractures of the pigs they used might be the same in different consignment from any single firm of pig iron makers, the composition varied to a considerable extent, and that corresponding variations resulted in their castings. At one works where advice was given how to prepare synthetically suitable meltings from local irons to replace more expensive material imported from a distance, the foreman expressed the view that the expert was a most dangerous man. In more than one establishment it is beyond doubt that when a chemist was introduced and his advice taken, something was done to produce a bad result. Before real progress could be made the foremen had to be replaced by men less prejudiced.

That cast iron of almost any desired properties could be produced, given the necessary varieties of raw pig irons, had been proved long ago, even in the early seventies, by one firm in this country which synthetically produced, and still produces, almost any kind of iron required, namely: White iron suitable for carburizing in the manufacture of crucible steel; iron having all the properties of cold-blast iron; iron suitable for the manufacture of chilled rolls, malleable castings, etc.; but this was only possible because, from the first, chemical assistance was employed. It is now generally admitted that the peculiar properties of every brand of iron are due to differences in composition.

Perhaps the greatest advance in foundry practice followed the researches of Professor Thomas Turner on the influence of silicon on cast iron. The astounding practical evidence of Charles Wood of Middlesbrough subsequently proved that by melting together two classes of iron from the same blast furnace, each of which was absolutely unfit to use by itself, a mixture was obtained which yielded high-class castings. The irons referred to were white iron and so-called "burnt" glazed iron, the former being deficient in silicon, the latter containing about 4 per cent of that element. Each iron was brittle by itself, but the mixture was good and even better than average foundry castings made from Nos. 3 and 4 foundry Middlesbrough irons. The market value of each of these irons (white and glazed) was low, and it was usual to put them back into the blast-furnace in small doses, thus working them off with the better metal. The value of such high-silicon glazed iron since that time has been recognized, and is in great demand at works where large quantities of inferior scrap or hard irons have to be melted in the foundry.

Even sulphur—the element all makers of pig iron endeavor to avoid—say from 0.1 to 0.15 per cent, is now considered essential in cylinder castings. Although for a long time the actual amount of graphitic carbon in castings was not considered worthy of consideration, it is now recognized that both the amount and character of the graphite has a direct bearing on the mechanical properties of the finished castings. Professor Turner and others have drawn attention to these facts. As an instance of the embrittling effect of large graphitic plates or flakes, it is only necessary to refer to the fact that a No. 1 hematite casting with 3 per cent silicon, 3 per cent graphitic carbon, and 0.5 per cent combined carbon has a tenacity of only 22,000 pounds per square inch. Metal of a similar composition without the graphitic carbon has a tenacity after forging of about 132,000 pounds per square inch. When sulphur pyrites are melted in the cupola with open iron so as to give 0.15 per cent of sulphur in the mixture, a closer-grained iron containing the graphitic carbon in fine plates may be obtained, which is stronger in consequence.

One great advance during the last 25 years was the production of castings by melting mixtures of steel scrap and blast-furnace metal in the cupola, for they were much superior in toughness and strength to those made from furnace metal alone.

The property of high percentages of silicon in cast iron, in enabling it to resist corrosion by acids, has led to the extensive use of evaporating pans and other vessels in chemical works made from cast iron alloys containing 10 per cent or more of silicon.

To the science of the foundry a large number of well-known authorities both in America and Europe have contributed important information.

From the presidential address of Dr. John E. Stead who recently was elected president of the Iron and Steel Institute at its annual meeting in London, England. Dr. Stead is one of the leading consultants and iron and steel metallurgists of Europe.

Moves Plant to Baltimore

The manufacturing plant and offices of the George Oldham & Son Co., makers of rammers, cleaning and shipping hammers, soon will be removed from Frankford, Philadelphia, to Scott & McHenry streets, Baltimore, Md. The Baltimore plant will be equipped for the manufacture of pneumatic tools.

How and Why in Brass Founding

By Charles Vickers

Making Cores for Small Brass Castings

We are experiencing difficulty in making small brass castings and bushings. The molten metal burns in through the cores and destroys the casting. Kindly advise us in regard to a suitable core composition to avoid this difficulty.

It would appear that the cores are too porous. Possibly the sand is too coarse, or the cores are made too soft. Without specific information in regard to the sand mixture used for the cores, and the composition of the metal poured around them, considerable guesswork is necessary to formulate an answer. A strong core mixture is suggested as follows: Sharp sand, 30 pounds; new molding sand 10 pounds; powdered rosin, 2 pounds. Have the sands dry when weighed. Mix the sands and the rosin, temper with water to the consistency of molding sand. The strength of the cores while green can be varied by increasing or decreasing the molding sand. A weaker core will result if floor sweepings are used in place of the new molding sand. The more sharp sand the weaker the green core will be, but it will vent more easily. The cores should be dried at a temperature that will melt the rosin, when the cores will smoke. After cooling this will prove a strong core. If a softer core is desired, decrease the amount of rosin.

Larger Risers Needed on Defective Castings

We have lately had considerable difficulty in making bronze castings of an alloy composed of copper, 78.75 per cent; tin, 8.25 per cent, and lead, 13.00 per cent. The castings weigh about 170 pounds each. They are poured at a temperature of around 1800 degrees Fahr., but fail to come sound, containing porous places and shrink holes. Any suggestions you may offer that may assist us in preventing this trouble will be greatly appreciated.

In our judgment the castings are not porous in the accepted sense of this term, that is, the difficulty is not due to gaseous metal. The fact they come porous in places and have shrink holes would indicate the entire difficulty to be one of molding. The risers are too small to feed the shrinkage of the castings, consequently the metal in the upper parts of the castings drains away to the lower parts leaving holes in the upper part, and these holes will be found at the root of the risers.

The remedy is a simple one; merely increase the diameter and the height of the risers until the trouble ceases. The question of cutting off the risers is a secondary one. Means must be found for doing this. We suggest a visit to a steel foundry and inspection of the risers necessary to get sound steel castings; also of the methods of removing these risers. While bronze can be made with smaller risers than steel, all too frequently a penurious policy is adopted in the brass foundry with the idea of saving molten metal. However, it is a direct loss if several castings have to be made to get one good one. Therefore, we advise the use of risers of generous size to properly feed the castings.

Casting Copper May Be Used

We specialize in making bronze memorial tablets and all classes of bronze ornamental work, using the following alloy: Copper, 88 per cent; tin, 5 per cent; zinc, 5 per cent; lead, 2 per cent. We would like to get your opinion in regard to whether it is best to use lake or casting copper. We use a bronze ingot of the same formula as given, and purchase this ingot from the refiners.

The difference between casting copper and lake or electrolytic copper is one of purity. The more nearly pure the copper is the higher will be its electrical conductivity, and as electrolytic copper has the highest conductivity, it follows this grade is the purest copper. For all purposes for which copper is used the purer it is the better, therefore, electrolytic is the best copper that can be obtained for making bronze ornamental work, as for everything else. It need not be decided from this statement that casting copper cannot be used for making bronze, as it can, and the bronze may be just as good as if electrolytic copper had been used. Again it may not be, a chance must be taken when using casting copper. It depends where the casting copper came from, and just what impurity it may contain. If it contains a little zinc, tin, or lead it would be satisfactory, but if it contains silicon or aluminum, even in minute quantity, it might make a poor grade of bronze. If a substantial saving can be effected by using casting copper, it is worth investigation, and a small shipment should be tried. If this proves satisfactory all is well, but provision should be made in advance to return the metal when a shipment is received which fails to give good results.

Baking Weak Cores

We are making small irregularly shaped castings having small holes cored in them, and have difficulty due to their contour which makes it impossible to place them on a plate. We dry the cores in the half core box which is of brass, and the core when dry adheres to the core box, and is broken by removal. We have oiled the box with lubricating oil, but the difficulty still persists. We would like to learn what binder we can use to better advantage than oil in this case?

For small, weak cores, oil is the best binder. Should there be large quantities of the castings to make, it will be necessary to have dryers of cast iron to support the core. These dryers are similar in shape to the half corebox and fit over the pins in the other half of the box. When the core is rammed the half box with holes is removed, the dryer takes its place, then the box is overturned and the other half is removed leaving the core in the dryer. The cores will not stick to these dryers, especially if they are warmed before being used. If there is only a small order to turn out, make a small wooden frame high enough to clear the core when it is placed over the same as it lies in the half core box; sieve molding sand over the core until the frame is filled covering the core, then fit a core plate on the sand filled frame like placing a bottom board on the drag of a mold, then invert the corebox with core, frame, sand and plate and lift off the corebox leaving the core on the plate embedded in soft molding sand which will hold it together until it is dried. When dry remove the core, and lightly brush away the dry molding sand. All oil-bonded cores require venting.

THE FOUNDRY

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Contents

Interest Centers on Columbus

EACH successive year since its inception has marked a long step forward in the work accomplished by the American Foundrymen's association. Last year at Philadelphia, the cradle of this great technical society, unprecedented attendance, an excellent program of papers and the largest assemblage of foundry equipment and materials ever brought together set a high mark which some stated would never again be attained. Although the Columbus convention still is several weeks away, it is thought by those whose judgment is based upon 20 or 25 years observation of the association's attainments, that this year will mark a gathering which will fully equal if not surpass that at Philadelphia. Technical papers, presenting the results of profound study and achievement in the varied lines of foundry activity, will be read by authorities in the subjects of greatest moment to the present day foundryman. More than 60 of these will be read and discussed at the gray iron, steel, malleable and nonferrous sessions of the association and at the meetings of Institute of Metals division of the American Institute of Mining and Metallurgical Engineers which latter will be held simultaneously.

Foundry supply and equipment manufacturers, who are ever quick to appreciate the opportunity this annual gathering offers them in the demonstration of their products, have engaged more space and will be represented in greater numbers than ever before. Seven large buildings at the Ohio State Fair grounds will be filled with exhibits which will show the most modern developments in the casting industry.

Foundry Iron Production Forges Ahead

AN INCREASE of 43 per cent in the production of malleable pig iron during the first half of this year over the same period last year is the feature of the official statistics of pig iron production recently issued. In the first six months of 1919 the production of malleable pig iron was 465,823 tons against 666,165 tons produced the first half of 1920. This is the largest increase in tonnage shown by any grade of pig iron for the period. The increase for all grades was 13.3 per cent; 16,278,175 tons in the first half of 1919 comparing with 18,435,602 tons in the same period of 1920. The production of foundry pig iron showed a gain of 22.3 per cent covering the same periods.

These higher relative gains for foundry and malleable pig iron would indicate that the foundries of the country were even more prosperous during this period than were the steel mills, although the latter enjoyed a marked prosperity. The increase in the output of malleable may not all be attributed to demand from malleable iron foundries as many shops making gray-iron castings of thin sections requiring a dense metal use malleable pig in their mixtures, notably those plants molding automobile cylinders. However, the melt for malleable castings has evidently increased as the capacity of malleable foundries has been augmented during the past 18 months by from 25 to 33 per cent according to an authoritative report. The demand for malleable castings has increased greatly and even with the added capacity prompt deliveries of castings are still difficult to procure. Some slack which has appeared in the demand for malleable castings, for the automobile trade is at present being more than taken up by the demands of the railroads.

Trade Outlook in the Foundry Industry

GREATER stability is apparent in all branches of industry with the entry of September. Improved shipping probably is the greatest single contributing factor to the return of confidence. With the feeling that better supplies of raw materials may be available and that they may be able to maintain shipments of finished products, manufacturers in general are more hopeful of the future. It still is realized that the railroad facilities of the country are entirely inadequate to handle well a peak load such as marked the past year, but improvements in operation have brought a temporary relief which it is hoped may continue until new equipment can be put in service.

Aids Coke Situation

Better rail conditions have reacted favorable to the advantage of foundries. Coke, which has been the chief cause for concern has been more readily available through better shipments from the mines and from the ovens. A slight recession in price has resulted, and it is probable that with continued improvement in the car supply, easier prices will obtain during the present month. An increase of 1 per cent in coke production in the Connellsville region was noted during the week ending Aug. 21 and the following week showed still greater shipments. The week of Sept. 1 registered a decrease in production, but continued improvement in railway conditions is shown by the shipment of a considerable tonnage of coke which had been stockpiled during the most stringent car shortage. Coke still is scarce in Alabama and all that can be produced is shipped and consumed in the territory about Birmingham. Delayed delivery on contract coke has served to keep the spot market tight, as all supplies which have been available have been shipped to meet the demand. The advance in freight rates has made little impression on coke prices, as better shipment has overbalanced the effect of this added cost.

Insist on Quality

With the return of more nearly normal conditions of supply, foundrymen are beginning to scan quality more closely. It has been notoriously evident for the past several months that the coke shipped to foundries has been far below standard. Urgent need has prompted many to accept this inferior coke, and 72-hour foundry coke has meant anything which the ovens have had available at the times when cars were to be had. Foundries have been obliged, under pressure of urgent necessity, to accept fuel which was taken from the ovens at the expiration of 48 hours or even less. This inferior fuel has been utilized, but with attendant cupola and casting troubles. Some of the larger by-product coke plants have maintained a better quality, and these have been able to command a premium price during the past two months. One case of a Pennsylvania foundryman is cited where $20 a ton and a $4.60 freight rate was paid for high quality coke when an inferior grade might have been obtained at $17 a ton and with less than $1 freight added.

Reaction at Hand

This growing insistence upon better quality is noted both in raw materials and finished products. Just as the foundryman is beginning to look closer upon furnace analyses of iron and quality of coke, so the consumer is becoming more exacting in his requirements. Automobile manufacturers, confronted by a reduction in scheduled production, took this means of retarding the flow of castings which was entering their plants. Those which two months ago were scouring the country seeking foundries which could supply them even 10 or 12 more cylinder castings per day found themselves suddenly obliged to curtail. To stop the oversupply of castings, many developed a keen system of inspection, which, while it may have been justified in some cases, threw a heavy burden upon the foundries. This meticulous inspection and rejection of castings has been accompanied in many instances by requests for deferred deliveries of castings contracted, and in some instances by actual cancellations of contracts extending through until next spring. Automobile shops, in general are optimistic and regard this slump in the production of passenger cars and trucks merely as a temporary condition which will be followed by an even greater demand. For this reason, few if any who find themselves with idle shop capacity are soliciting work of any other character. With few exceptions automobile shops alone have been adversely affected by recent reactions in many lines. Malleable foundries, particularly those engaged in railway and agricultural implement work have all the business that they can handle. Most jobbing shops, particularly those handling light work have sufficient business on their books to engage their capacity until the first of the year, and although there is little new work originating at this time, they are confident that a better outlook, following the fall campaign, will assure a continuance of their present prosperity. Stove and furnace establishments report undiminished demand. Cast-iron pipe is not so active, due to the inability of municipalities to dispose of bonds to finance badly needed extensions to water and gas mains. It is felt that with the return of better credit conditions, much of this demand which has been held back will materialize. Prices of nonferrous metals based on New York quotations of Sept. 7 follow: Copper, 17.87½c to 18.00c; lead, 8.25c to 8.50c; Straits tin, 45.00c; antimony, 7.12c to 7.25c; aluminum, No. 12 alloy, producers' price, 34.00c and open market, 31.50c. Zinc is quo[illegible] 7.90c East St. Louis.

Prices of Raw Materials for Foundry Use

CORRECTED TO SEPT. 7

Iron	
No. 2 foundry, valley	$48.00 to 50.00
No. 2 Southern, Birmingham	42.00 to 45.00
No. 2 Foundry, Chicago	46.00 to 47.00
No. 2 Foundry, Philadelphia	51 25 to 53.50
Basic, Valley	48.50
Malleable, Chicago	46.50
Malleable, Buffalo	51.25

Coke	
Connellsville foundry coke	$18.00 to 18.25
Wise county foundry coke	18.50 to 20.00

Scrap	
Heavy melting steel, Valley	$27.50 to 27.75
Heavy melting steel, Pittsburgh	29.00 to 29.50
Heavy melting steel, Chicago	26.00 to 26.50
Stove plate, Chicago	32.00 to 32.50
No. 1 cast, Chicago	40.50 to 41.00
No. 1 cast, Philadelphia	39.00 to 41.00
No. 1 cast, Birmingham	33.00 to 35.00
Car wheels, iron, Pittsburgh	47.50 to 48.50
Car wheels, iron, Chicago	39.00 to 39.50
Railroad malleable, Chicago	33.00 to 33.50
Agricultural malleable, Chicago	33.00 to 33.50

Comings and Goings of Foundrymen

JAMES T. LEE recently has resigned his position as vice president in charge of sales of the Hanna Engineering Works, Chicago, to join the sales engineering staff of the Southwark Foundry & Machine Co., Philadelphia. It is the purpose of the Southwark company to broaden its field of activity by adding to its present production of hydraulic and power machinery, a full line of pneumatic and hydropneumatic riveters and foundry molding machines. Mr. Lee received

JAMES G. LEE

his education in the manual training schools of Philadelphia and in the engineering department of the University of Pennsylvania. He has been closely associated with the foundry trade for the past 15 years. From 1906 to 1911 he was treasurer of the Rathbone Molding Machine Co., and subsequently has been western sales manager for the Mumford Molding Machine Co. and the Q. M. S. Co. He has been an active member of the Chicago Foundrymen's club, the American Foundrymen's association and a director of the Foundry Equipment Manufacturers' association.

P. H. Donavan has been made general manager of the National Brake & Electric Co., Milwaukee.

H. J. Landis, Lansdale, Pa., has sold his interest in the Lansdale Foundry Co. to I. F. High, who has assumed the active management of the company.

R. J. Wells has been promoted to the position of general foreman of the Portsmouth Metal & Foundry Co., Portsmouth, Va.

William Grede has purchased the Liberty Foundry Co., Milwaukee. Mr. Grede for some time has been associated with the Wagner Castings Co., Decatur, Ill.

B. H. Hartsfield, vice president of the Birmingham Stove Works, Birmingham, Ala., has been elected president of the Birmingham Civic association.

O. M. Swartz, who has been burgess of the borough in which he resides, has been promoted to the position of foreman of the Wincroft Stove Works, Middletown, Pa.

Julius Janes, formerly president of the Standard Steel Castings Co., Cleveland, now is sales representative in Cleveland and Cuyahoga county of the Farrel-Cheek Steel Foundry Co., Sandusky, O.

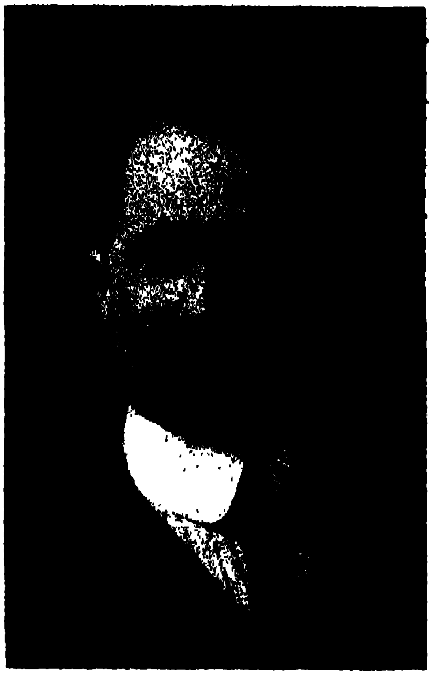
John S. Williams has resigned his position with the Gould Coupler Co., Chicago, to accept that of general superintendent of the Superior Steel Castings Co., Benton Harbor, Mich. Mr. Williams' new position became effective Sept. 1.

Frank M. Welsh, who for a number of years was in the employ of the Republic Iron & Steel Co., and later with Hickman, Williams & Co., New York, and Knapp & Baxter, New York, has been made district sales manager, with offices in New York City for the Iron Trade Products Co., Pittsburgh.

Dr. W. D. Bancroft, professor of physical chemistry at Cornell university, Ithaca, N. Y., has been engaged in consulting capacity in connection with the research laboratories of the Norton Co., Worcester, Mass. He expects to spend as much time at the Worcester and Niagara Falls plants each month as he can spare from his college work.

Robert M. Gates has been appointed managing engineer in charge of the Philadelphia district of the Lakewood Engineering Co., Cleveland. Mr. Gates who is a graduate of Purdue university is chairman of the Material Handling section of the American Society of Mechanical Engineers. For the past 12 years he has been actively associated with developments of mechanical means for conserving labor in construction, industrial and transportation lines.

E. F. Ball, Newark Stamping & Foundry Co., Newark, O., recently was elected president of the National Association of Pattern Manufacturers at the annual convention held in Toledo, O. Other officers of the association follow: Vaughan Reid, City Pattern Works, Detroit, and J. V. Brost, Brost Pattern Works, Cleveland, vice presidents; E. O. Melvin, Melvin Bros., Pattern Works, Columbus, O., secre-



FRED J. BRUNNER

tary and treasurer. A. E. Schuchert, A. E. Schuchert Pattern Works, Cincinnati; J. H. Bridge, Maumee Pattern Co., Toledo, O., and William Neilson, Boston, were elected trustees.

Fred J. Brunner, one of the best known foundry supply men in the business, recently has become affiliated with the Hill & Griffith Co., Cincinnati, in the capacity of secretary and sales manager. In 1893 he started with the J. D. Smith Foundry Supply Co., which was located in Cincinnati at that time. After severing his connection with the J. D. Smith Co., he was associated with the S. Obermayer Co., Chicago, for 16 years as assistant manager at the general office in Cincinnati. Since its origin seven years ago Mr. Brunner has been connected with the Hill-Brunner Foundry Supply Co.

Obituary

William E. Sessions, president of the Sessions Foundry Co., Bristol, Conn., and for many years at the head of several of the largest business enterprises in that city, died suddenly on the morning of August 27 at his home on Bellevue street. Mr. Sessions was born in Bristol, Feb. 18, 1857 and spent all his life there. His school days in Bristol and high school days in Hartford being followed by intimate association with the enterprises founded by his father the late John Humphrey Sessions.

After a year or two in the office of J. H. Sessions & Son, he entered in 1879 into the management of the foundry which his father had just bought, and which later became one of the largest in the state. Beginning with a force of about a dozen men the business steadily grew until it became one of the large industries in the city.

At the time of his death Mr. Sessions was president of the Sessions Foundry Co., president of the Sessions Clock Co., and also of the Bristol Trust Co. He was one of the organizers of the latter company and had been president since its formation. He was a director in all three, a trustee of Wesleyan university and a member of the executive committee. He was a member of the first board of burgesses of Bristol and in 1908 was a republican presidential elector, voting for William H. Taft.

Mr. Sessions married Emily D. Brown of Ellington, June 12, 1878. Besides his widow he is survived by two sons, Joseph B. Sessions, treasurer of the Sessions Foundry Co. and William Kenneth Sessions, vice president of the same company.

H. I. Wassenstrom, president of the Acme Brass Foundry Co., 4042 Liberty avenue, Pittsburgh, died at St. Margaret's hospital, in that city, on July 21. Mr. Wasserstrom formerly lived in Cleveland.

Book Review

The Strategy of Minerals, edited by George Otis Smith, director of the United States geological survey; 5 x 8 inches, 360 pages; published by D. Appleton & Co.; furnished by THE FOUNDRY for $2.50.

This book sets forth the essential part that minerals played in the Great War, it records our wartime experiences and discusses the part that mineral raw materials now have in the reconstruction of the world. It opens with a discussion on the relation of geographical position and economic resources in their relation to international commerce with particular reference to mineral raw materials. It then goes on to describe the disturbance of the mineral industry of the United States through war conditions and deals exhaustively with the shipping crisis. Each main group of mineral raw materials is treated by a recognized authority, the survey covering [illegible] war's demands, the problems and means of increased production, technical progress, new sources of material, reserve supplies, etc. A chapter of [illegible] deals with present tendencies of power production to further the conservation of mineral fuels and another chapter traces the history and activities of the fuel administration during the war. The concluding chapters deal with the future place of the United States in the world market and its obligations as custodian of the world's greatest repository of mineral raw materials. A comprehensive index at the back furnishes a means of quickly finding subjects.

Foundrymen's Association Seeks Members

The American Foundrymen's association has designated Sept. 20-25 as a special "Foundrymen's Week" during which time concerted effort will be made to reach all nonmember foundrymen with a personal invitation to join. The committee on promotion and membership is enlisting the co-operation of members in all parts of the country and team captains are being appointed for each city or group of towns. Application for membership before or during "foundrymen's week" will be acted upon by the American Foundrymen's Association board of directors in time to qualify the applicants with full membership privileges for the annual convention in Columbus, week of Oct. 4.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The Springfield Malleable Iron Co., Springfield, O., is erecting an additon to its plant.

The Rogers Foundry Co., Joplin, Mo., has opened a malleable iron foundry at Baxter Springs, Kans.

The Allerton Foundry Co., Niles, Mich., recently was incorporated with a capital stock of $50,000.

The Unit Stove Co., Birmingham, Ala., plans to enlarge its plant.

The plant of the Stieger & Kerr Stove & Foundry Co., 2201 Folsom street, San Francisco, recently was damaged by fire.

The Kenton Hardware Co., Kenton, O., has strated work on the erection of an addition to its foundry, 60 x180 feet.

The National Alloys Co., Woodbridge street, Detroit, is having plans prepared for the erection of a foundry 60 x 100 feet.

The New Idea Spreader Co., Coldwater, O. has awarded a contract for the erection of a foundry, 117 x 157 feet.

The Bucyrus Copper Kettle Works, Bucyrus, O., manufacturer of copper, brass and other metal products, has awarded a contract for the erection of a new plant building, 60 x 235 feet.

The M. D. Jones Foundry Co., Concord, Mass., which recently completed the erection of a plant, 38 x 90 feet, will start operations soon.

The Kilburn-Lincoln Machine Co., Fall River, Mass., has let a contract for the erection of an addition to its foundry to be 40 x 45 feet.

The Reading Valve & Fittings Co., Reading, Pa., has had plans prepared for the erection of an addition to its plant.

The Salem Foundry & Machine Corp., Roanoke, Va., is reported planning the erection of a foundry and machine shop.

The Joplin Foundry Co., Joplin, Mo., has started construction of a new office and warehouse building at its plant. It will be 50 x 50 feet.

The capital stock of the Kilby Pipe & Foundry Co., Birmingham, Ala., recently was increased from $30,000 to $100,000.

The James J. Lacy Co., Block and Wills street, Baltimore, [illegible] planning the erection of an addition to its plant, 52 x 70 feet. The company manufactures iron and steel castings.

The Sharp Foundry & Supply Co., New Philadelphia, O., is making some improvements at its plant.

The Woodhill Brass Co., Cleveland, recently was incorporated with a capital stock of $100,000, by J. P. Ferencik, F. R. Noss and others.

The West Point Foundry Co., West Point, Pa., has been incorporated with a capital stock of $30,000, by S. B. Strauss, Herbert L. James and others.

The Sandusky Foundry & Machine Co., Sandusky, O., has acquired property adjoining its plant including a building, which will be remodeled for use as a pattern shop.

The Chicago Nipple Mfg. Co., 910 West Lake street, Chicago, manufacturer of valves, fittings, etc., is reported to be considering improvements to its plant.

The Eastern Foundry Co., 152 Main street, [illegible] Rye, N. J., manufacturer of iron and [illegible]

fixt. etc., has increased its capital stock from $350,000 to $1,000,000.

The East Penn Foundry Co., Macungie, Pa., has started preliminary work in its new foundry. Additional equipment will be installed.

The Lewiston Foundry & Machine Co., Lewiston Pa., is devoting operations almost exclusively to the manufacture of sand pulverizing machinery and parts.

The Burnside Steel Co., 1300 East Ninety-second street, Chicago, has awarded a contract for the erection of a 1-story core room, office and pattern shop, 40 x 100 feet.

The American Woodworking Machinery Co., 591 Lyell avenue, has awarded a contract for the erection of a machine shop, 2-stories, 90 x 300 feet, and a foundry 110 x 130 feet.

Capitalized at $25,000, the Kaufer Mfg. Co., New York, recently was incorporated to engage in the manufacture of stoves, etc., by A. R. Locke, M. and T. Kaufer, 500 Southern boulevard.

The Oldsmar Tractor Co., Oldsmar, Fla., plans to erect a machine shop and foundry and will enlarge its output. The company recently increased its capital. H. R. Keller is general manager.

The National Woodworking Machinery Co., Dover, N. H., has awarded a contract for the erection of a machine shop, 35 x 100 feet, a foundry, 50 x 100 feet and a pattern shop, 40 x 100 feet.

The Omega Valve Co., Atlantic City, N. J., has been incorporated with a capital stock of $100,000, to manufacture plumbing fixtures, etc., by B. A. Burris, W. Barrett and Charles Park.

The foundry formerly occupied by the Northampton Iron Works, West street, Florence, Mass., has been turned over to Ernest Moeckel, who has been in charge of the Easthampton Foundry, Easthampton, Mass.

The American de Lavaud Mfg. Co., Ltd., Toronto, Ont., has been incorporated with a capital stock of $7,500,000, to manufacture cast iron, brass, etc., by F. A. Blackburn, 93 Lonsdale road, Toronto, John H. Phippen and Hugh J. Dawson.

The J. H. Charles Co., Ltd., Dunnville, Ont., has been incorporated with a capital stock of $40,000, by J. H. Charles, 327 Evelyn avenue, Dunnville, Albert Frances and George H. Orme, to manufacture castings, etc.

The Watson-Stillman Co., 190 Fulton street, New York, manufacturer of pumping machinery, brass and other metal castings, etc., has awarded a contract for the erection of an addition to its plant at Aldine, N. J.

The Johnson Bronze Co., South Mill street, New Castle, Pa., has awarded a contract for the erection of a machine shop, 2-stories, 32 x 62 feet, a core building, 52 x 68 feet, and a foundry, 65 x 100 feet.

The Colonial Foundry Co., Louisville, O., has increased its capital stock from $65,000 to $250,000, and will make improvements and extensions to its plant with a view to making heavier castings. A 10-ton crane will be installed.

The capital stock of Foster, Merriam & Co., Merriam, Conn., manufacturer of brackets, castings, etc., will be increased to $1,000,000 to take care of improvements and increasing business. R. W. Millard is president of the company.

The Ashland Malleable Co., Ashland, O., recently organized with a capital stock of $150,000, has acquired a 4-acre site on which it will build a malleable iron foundry, 100 x 200 feet. J. H. Firestone is president.

Lewis R. Palmer and George C. Palmer of Ridley Park, Pa., were named among the incorporators of the Mt. Holly Foundry Co., which recently was incorporated in Delaware with a capital stock of $100,000.

The Rice Valve & Foundry Co., Indianapolis, has been incorporated with a capital stock of $30,000, and will engage in the manufacture of valves, etc. The incorporators are Reece Rice, Albert Wenner and Carl R. Reynolds.

The pattern shop and storeroom of the Canada Iron Foundries, Ltd., St. Thomas, Ont., and the casting, foundry, material sheds and shipping room of the Dominion Brake Shoe Co. recently, were damaged by fire.

S. D. Lane, Alliance, O., is said to have sold his plant at Alliance, known as the Marm Car Indicator Co., to interests which are organizing a foundry company. Repairs are under way and it is expected to plant will be in operation by Nov. 1.

The Huntington Steel Foundry Co., Huntington, Ind., has been reorganized and refinanced. The new stockholders include, W. H. Armstrong, Racine, Wis., Edward T. Pelton, N. I. Silver and Leo Cohan. Gray iron work will be abandoned and steel castings will be made exclusively.

D. Round & Son, Cleveland, manufacturer of chain and chain hoists, will erect a foundry adjoining its plant which will be 100 x 150 feet, and equipped for the present with one cupola. This plant will be used for the manufacture of gray iron castings.

Work has started on the addition to the molding floor of the Mansfield Foundry Co., Mansfield, Mass. The addition is to be 90 x 120 feet and will be served by an additional 10-ton crane, contract for which has not yet been awarded. E. J. Morrow, manager, states the addition probably will be ready for operation by Oct. 1.

To keep pace with its expanding business the Harrold Tool & Forge Co., Columbiana, O., has been granted permission to increase its captal stock from $25,000 to $50,000. The firm, which operates a foundry and metal works at Columbiana, is planning to erect an addition. New machinery will be purchased.

Erection of a new brass foundry with approximately 15,000 square feet of floor space, will be started shortly for the Claus-Automatic Gas Cock Co., Becker and Booth streets, Milwaukee. The company is interested in all types of labor-saving foundry equipment, including tumbling, melting and metal curving devices. Walter E. Claus is an officer of the company.

The Roberts Mfg. Co., 106 South Tennessee street, Atlantic City, N. J., has an option on a factory building, and is said to be in the market for punches, lathes, milling machines and foundry equipment. The company was recently organized with a capital stock of $125,000, to manufacture well points, pumps, soil pipe and fittings. F. J. Fries is president, Levi D. Roberts, vice president and George A. Evans, secretary-treasurer.

Intending to build in the spring, the New England Smelting & Refining Co., Pleasant street, Ansonia, Conn., has rented and equipped a foundry where solder, babbitt, etc., will be manufactured. This company recently was incorporated with a capital stock of $50,000, by Nathan Britsker, D. Simons, G. Liftig, S. J. Liftig and L. Egger.

Contract for the erection of the first building, 100 x 140 feet, of the plant for the Porter Tractor Co., Collins, Iowa, has been awarded and work on the structure is now under way. The building will be utilized for offices, assembly room and machine shop. Later, other buildings will be erected including a foundry. As yet the company has not closed on its foundry, heating plant, machine shop and general factory equipment.

Negotiations are in progress for the transfer of the Cedar Grove Stove Co., Cedar Grove, Wis., to new interests represented by Peter Dittlchoff, who recently resigned as superintendent of the foundries of the Beaver Dam Malleable Range Co., Beaver Dam, Wis. The Cedar Grove company was organized in 1901 to make stoves and malleable castings, and at present is capitalized at $50,000. John Van de Wall is president.

To cope with the steadily increasing demand for its products, the A. E. Martin Foundry & Machine Co., 705 Park street, Milwaukee, will make its second important plant extension this year. Plans have been completed for the erection of a brick and steel gray iron foundry addition, 82 x 145 feet and a new coreroom, 100 x 100 feet. With additions recently completed, the capacity of the plant is increased to about 25 tons a day and this extension will further increase the output to 35 or 40 tons a day.

For the purpose of operating a foundry and machine shop the Bayside Foundry Co., Fall River, Mass., recently was incorporated with a capital stock of $300,000, and arrangements have been made for the taking over of the Mechanic's Foundry & Machine Co. The company also is said to be planning to establish other plant units in New England. Officers of the company are: President, Jerome P. Fogwell; treasurer, Julius P. Sokoll, auditor and cost accountant, Rufus B. Deland and directors, Herbert Austin and Robert W. McGregor.

New Trade Publications

FORGES.—Wright Bros. Mfg. Co., Ft. Worth, Tex., is circulating a card circular in which a knockdown forge is described and illustrated. The forge is 42 inches square and 28 inches high.

FOUNDRY EQUIPMENT.—Jolters, squeezers, pouring devices, stripping machines and other foundry equipment, are described and illustrated in a 4-page folder being circulated by the Arcade Mfg. Co., Freeport, Ill.

STREET LIGHTING.—The latest developments and recommendations for street, boulevard and parkway lighting are described and illustrated in a bulletin being circulated by the General Electric Co., Schenectady, N. Y.

MOTOR TRUCK.—The Acme Motor Truck Co., Cadillac, Mich., has published an illustrated booklet in which the various points of trucks which the company manufactures, are called to the readers attention. Specifications, etc., are given.

DEFLECTION POTENTIOMETER.—The General Electric Co., Schenectady, N. Y., has issued a bulletin in which a deflection potentiometer is described and illustrated. It is designed particularly for giving accuracy between the precision potentiometer and the laboratory standard instrument.

PORTABLE ELECTRIC TOOLS.—The Independent Pneumatic Tool Co., Chicago, has published a 4-page folder, in which portable electric drills, grinders, etc., are described and illustrated. One illustration shows an electric drill equipped with a new pistol grip handle, being used on a motor truck frame.

WELDING EQUIPMENT.—Oxy-acetylene welding and cutting apparatus and carbide lights, are described and illustrated in a booklet being circulated by the Alexander Milburn Co., Baltimore. In addition accessories for this equipment is also described. The illustrations show the various equipment and each is described in full.

ENAMELING.—The Porcelain Enamel & Mfg. Co., Baltimore, is circulating an illustrated booklet in which complete data on porcelain enameling plant equipment is given. The booklet is well illustrated showing various plants where this equipment is used. The front of the book contains data and descriptions of the various process of enameling as well as a short history of the art.

PUBLICATIONS.—The American Society of Mechanical Engineers, New York, has issued a list of papers and discussions published by the society. Another folder being circulated by the society calls attention to the *Engineering Index*, a book which it publishes, and which contains a record of the world's engineering progress during 1919. The book contains over 500 pages and treats on more than 5000 subjects.